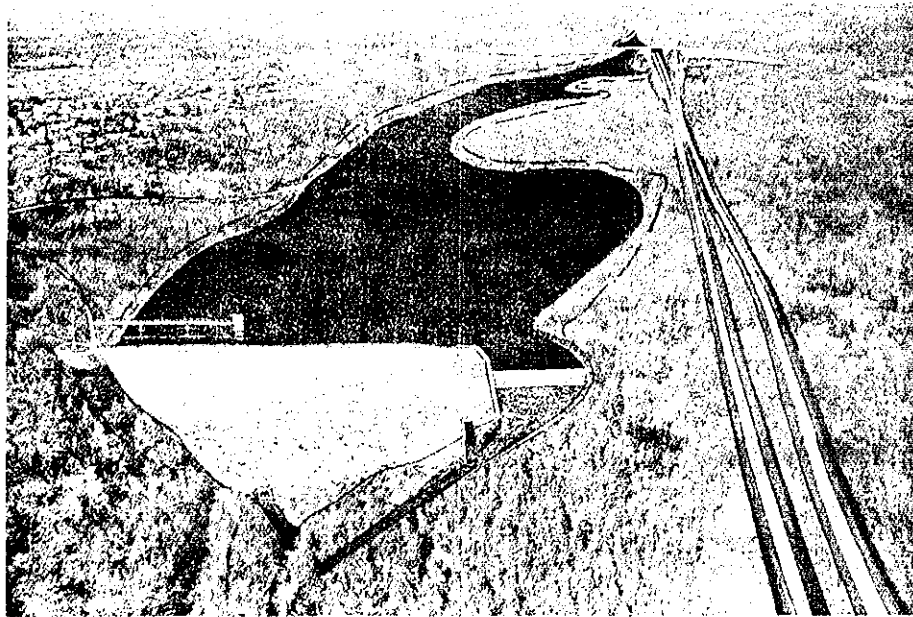


Sm. Projects Dept.
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**NORTHEAST FLOOD STUDIES
REPORT
ON
REVIEW OF SURVEY
FOR
FLOOD CONTROL AND ALLIED PURPOSES
PEQUONNOCK RIVER BASIN
CONNECTICUT**



**U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.**

14 MAY 1965

REPORT
ON
REVIEW OF SURVEY
FOR
FLOOD CONTROL AND ALLIED PURPOSES

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U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS, WALTHAM, MASS.

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SYLLABUS

The Division Engineer finds that the Pequonnock River, a small coastal stream in southwestern Connecticut, has caused major flood damages in the city of Bridgeport and the town of Trumbull. He further finds that additional water supply for municipal and industrial use will be needed in the near future, and that water-oriented recreation is in great demand in the area. He concurs with the findings of the Public Health Service of the Department of Health, Education, and Welfare and the Fish and Wildlife Service of the Department of Interior that storage of water for low flow augmentation is a desirable and necessary adjunct to any reservoir project in the basin.

The Division Engineer finds that a dam and reservoir on the Pequonnock River in Trumbull, Connecticut is feasible and is economically justified. The project would provide for storage of water for flood control, for municipal and industrial water supply, for water quality control, and for recreation, compatible with local laws applying to permitted uses of a water supply reservoir.

The Division Engineer recommends for construction the Trumbull Pond Dam and Reservoir encompassing these purposes,

subject to certain requirements of local cooperation pertaining to the water supply and recreation aspects of the project. The total estimated cost of the project is \$5,000,000, of which \$2,475,000 would be reimbursable under provisions of the Water Supply Act of 1958, as amended. An additional \$25,000 would be reimbursable under the provisions of the proposed "Federal Water Project Recreation Act".

REPORT ON REVIEW OF SURVEY
FOR FLOOD CONTROL AND ALLIED PURPOSES
PEQUONNOCK RIVER BASIN
CONNECTICUT

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INFORMATION CALLED FOR BY SENATE
RESOLUTION 148
(Follows Appendix I)

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND

CORPS OF ENGINEERS

424 TRAPELO ROAD

WALTHAM, MASS. 02154

ESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO.

NEDED-R

14 May 1965

SUBJECT: Report on Review of Survey for Flood Control and Allied
Purposes, Pequonnock River Basin, Connecticut

TO: Chief of Engineers
ATTN: ENGCW-PD

SECTION I - AUTHORITY

1. AUTHORIZING RESOLUTION

This report is submitted pursuant to authority contained in a resolution of the Committee on Public Works of the United States Senate which reads in part:

"That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review previous reports on (major rivers in northeastern United States) and intervening streams; in the area affected by the hurricane flood of August 1955, to determine the need for modification of the recommendations in such previous reports and the advisability of adopting further improvements for flood control and allied purposes in view of the heavy damages and loss of life caused by such floods. "

SECTION II - SCOPE

2. SCOPE OF REPORT

This report covers the Pequonnock River basin, a small coastal stream in southwestern Connecticut. Flood problems of other coastal streams intervening between the major river basins in the region will be considered in future reports. The area covered by this report is shown on Plate 1.

Tidal flooding along the Pequonnock River in Bridgeport from the River Street bridge to the mouth of the river, caused by hurricanes and severe coastal storms, was studied under authority of Public Law 71, 84th Congress, 1st Session. In a report dated 22 May 1964, the Division Engineer found that, under current conditions, improvements for hurricane protection at Bridgeport by the Federal Government are not warranted at this time.

3. SCOPE OF STUDIES

a. Surveys and studies. U. S. Geological Survey maps to a scale of 1:24,000 with 10-foot contours, and aerial photogrammetric maps to a scale of 1" = 200' with 5-foot contours were used in the study. Sub-surface investigations consisted of field reconnaissance by geologists and soil engineers. A survey of flood damages was made in 1963 as part of a survey of all coastal streams affected by the floods of 1955. Office studies consisted of hydrologic and hydraulic analyses and estimates of quantities and costs of major items of construction and real estate for the various considered projects.

b. Consultation with interested parties. A public hearing was held in Trumbull, Connecticut on 8 December 1964, at which time the results of this study were presented. A synopsis of the hearing is given in Section XVII. Meetings have been held with officials of the town of Trumbull, the Bridgeport Hydraulic Company, which provides water services, and Federal and State agencies in the field of water resources development.

c. Field reconnaissance. Field reconnaissance of the problem area has been made by the Division Engineer and representatives of his office.

SECTION III - PRIOR REPORT

4. "RESOURCES OF THE NEW ENGLAND-NEW YORK REGION"

Flood control and allied water uses in the Pequonnock River Basin were considered in Part Two, Chapters XXIII and XXIV titled "Connecticut Coastal Area," and "Special Subjects, Subregion 'B'," respectively, of the report The Resources of the New England-New York Region. This comprehensive report presented an inventory of the resources of the New England-New York area and recommended a master plan to be used as a guide for the regional planning, development,

conservation, and use of land, water, and related resources of the region. Prepared by the New England-New York Inter-Agency Committee, the report was submitted to the President of the United States by the Secretary of the Army on April 27, 1956. Part One and Chapter I of Part Two are printed as Senate Document 14, 85th Congress, 1st Session. The report found that flooding had not been a serious problem in the Connecticut coastal areas (the report was prepared prior to the August and October 1955 floods); that existing fresh surface and ground water sources are insufficient to satisfy the future requirements of the region; and that opportunities for recreation and for fish and wildlife should be expanded. No recommendations for meeting these needs were made.

SECTION IV - BASIN DESCRIPTION

5. LOCATION AND EXTENT

The Pequonnock River basin, located in Fairfield county in southwestern Connecticut, drains an area of 28.3 square miles upstream of the River Street bridge in Bridgeport. Of this area, 3.3 square miles lie in the city of Bridgeport, 15 square miles in the town of Trumbull, and 8.8 square miles in the town of Monroe, while the remaining 1.2 square miles are divided between the borough of Newton and city of Shelton. The basin has a length of about 10 miles and a maximum width of 3.3 miles. Plate 1 shows the area covered in this report.

6. TOPOGRAPHY

The basin is moderately hilly throughout, with tops of numerous hills rising to about 300 feet above the elevation of the river bed in the vicinity. The highest elevation is about 700 feet above sea level at the northwest perimeter of the basin. Residential and rural areas are extensive in the upper portion, while industrial and commercial centers are concentrated in the lower portion, especially in the city of Bridgeport.

7. GEOLOGY

The Pequonnock River basin is one of several small coastal watersheds which lie between the Hudson River and Housatonic River basins and drains generally southward to Long Island Sound.

Its upper area traverses pre-Acadian sediments which were crystallized, becoming metamorphic rocks. Drainage in this area reflects former major drainage courses of the region, which trended to the southeast. The lower part of the basin crosses more resistant post-Acadian plutonic rocks, which trend northwest-southeast and form resistant masses. These rocks formed a base level which resisted further south-eastward movement of drainage and caused a southerly course of the river; hence its mouth, at Bridgeport, is narrow.

Overburden on the ridges is a thin till cover, while glacio-fluvial silts, sands and gravels lie in the bottoms of depressions between the ridges. Drainage is poor, and thin flood plain or marsh deposits occur locally.

8. STREAM CHARACTERISTICS

a. Main stream. The Pequonnock River is formed by the East and West branches, which rise in the low hills in the town of Monroe and join just north of the Monroe-Trumbull town line. Booth Hill Brook and Island Brook are the only major tributaries entering the river below the confluence of the East and West branches. Throughout its 9.6-mile length to tidewater, the main stem falls about 300 feet in a series of relatively flat reaches connected by steep, rocky rapids and falls.

b. Tributaries.

(1) West Branch. The West Branch Pequonnock River, originating in Pine Swamp, north of the Monroe town line, drains an area of about 4.6 square miles. The stream bed falls about 160 feet in its 5-mile length. A canal, located 1.2 miles above the confluence with the East Branch, is used to divert some of the runoff from about 3.9 square miles of the West Branch drainage area into the Mill River and thence into the Easton water supply reservoir.

(2) East Branch. The East Branch, Pequonnock River, originating in the northernmost part of the basin, drains an area of about 3.7 square miles and falls about 150 feet in its length of 4.5 miles. The central portion of the watershed has a flat gradient and contains a relatively large amount of valley storage.

(3) Booth Hill Brook. Booth Hill Brook, joining the Pequonnock River about 3.5 miles above tide water, has a drainage area of 5.5 square miles. The 60-acre Pinewood Lake on this tributary is privately owned. The stream bed falls 70 feet within the half-mile reach immediately below the lake outlet for a fall of 90 feet in 1.2 miles.

(4) Island Brook. This tributary joins the Pequonnock at tide water within the city of Bridgeport. Most of the 3.1-square mile drainage area lies within highly developed residential sections of Trumbull and Bridgeport, with the lower portion flowing through concentrations of commercial and industrial developments. Lake Forest, located 2.5 miles above the mouth of the brook and covering an area of about 65 acres, is surrounded with private developments. Below the lake, the stream bed is relatively steep, falling about 150 feet to the confluence.

9. NATURAL RESOURCES

a. Water supply. The Pequonnock River is of relatively good quality and an important potential source of water supply. It is the last unused source of fresh surface water supply feasible of development in the area around Bridgeport. The region is one of burgeoning population with corresponding increasing demands on water resources for water supply and for maintenance of water quality.

b. Recreation. The Pequonnock River basin provides great potential for such outdoor recreation as swimming, boating, picnicking, camping, and hiking. Having unpolluted water as far downstream as the Bridgeport line, the basin provides a convenient sport fishery located near areas of concentrated population. Indeed, this strategic location magnifies the value of all the basin recreational facilities.

SECTION V - WEATHER AND FLOODS

10. TEMPERATURE

The Pequonnock River basin has a variable climate and, due to its proximity to the Atlantic Ocean, escapes the severity of cold and depth of snowfall experienced in the higher elevations of interior New England. The average annual temperature of the basin is about 51°F. Extremes in temperature range from occasional highs of 100°F. to lows of -20°F.

11. RAINFALL

The mean annual precipitation over the basin is about 48 inches and is distributed approximately uniformly throughout the year. Monthly extremes at Bridgeport, however, have varied from a high of 18.77 inches in July 1897 to a low of less than 0.1 inches on occasions.

12. FLOODS

Major floods in the Pequonnock River basin have usually been caused by heavy rainfall associated with storms of tropical or extra-tropical origin which have traveled northward along the Atlantic coast. The largest floods in the basin occurred in July 1897, July 1905, March 1936, September 1938, December 1948, and August and October 1955. The floods of March 1936 and December 1948 were exceptional in that they were produced by winter-type cyclonic storms. The largest and most damaging flood in the basin since the turn of the century occurred in October 1955.

13. FLOOD FREQUENCIES

The frequency or percent chance of occurrence of peak discharges in the Pequonnock River was determined from a regional analysis based on records at U. S. Geological Survey gaging stations on nearby streams. The frequency analysis, made in accordance with standard methods of the Corps of Engineers, indicated that the October 1955 flood, which had an estimated flow of 5,800 c.f.s. (cubic feet per second) at the Boston Avenue bridge in Bridgeport, was a 50-year flood or had a 2 percent chance of occurrence in any given year.

14. STANDARD PROJECT FLOOD

A standard project flood is a synthetic flood used by the Corps of Engineers to measure the flood potentialities of a river basin. It represents flood discharges which may be expected from a combination of severe meteorological and hydrologic conditions that are considered reasonably characteristic of the geographic region involved, excluding extremely rare combinations. The standard project flood is used as criteria for establishing design grades for walls and dikes in local protection projects, for determining the desirable design capacity of channel improvement projects, and for checking the effectiveness of flood control reservoirs.

The standard project flood for the Pequonnock River has a peak discharge of 16,100 c. f. s. at the Boston Avenue bridge and would be a 200-year flood or have a 0.5 percent chance of occurrence in any given year.

SECTION VI - POPULATION AND ECONOMIC DEVELOPMENT

15. POPULATION

The population of the basin is concentrated almost entirely in two towns and one city. The last two United States Censuses number them as follows:

<u>Municipality</u>	<u>Population</u>	
	<u>1950</u>	<u>1960</u>
Bridgeport	158,709	156,748
Trumbull	8,641	20,379
Monroe	2,892	6,402

The greatest concentration of population occurs at Bridgeport, which is the second largest city in the State. Smaller concentrations are found in the primarily residential parts of the basin: at Trumbull Center and Long Hill, in the town of Trumbull; and at Stepney and Upper Stepney, in the town of Monroe.

It is estimated that over 400,000 people live within a 10-mile radius of Trumbull, and one million live within a 25-mile radius.

16. MANUFACTURING

Nearly 54 percent of the labor force in the Bridgeport labor market area, composed of Bridgeport and contiguous towns, is employed in manufacturing. Manufactured goods include aluminum and zinc castings, automobile bodies, brass goods, cartridges and firearms, electrical apparatus and appliances, fabricated metals, machine tools and accessories, plastics, sewing machines, steam specialties, and wiring devices.

17. AGRICULTURE

Fairfield County - in which the Pequonnock River lies - is a region of densely populated centers and of areas of accelerating

real estate development. Mainly because of these conditions, the price of agricultural land in the county is over three times the average for the entire state. Value of crops harvested in the county averaged \$135 per acre, and in the entire state, \$201 per acre, according to U. S. Agricultural census figures for 1950.

Fruit growing is practiced in the basin, several orchards being located in Trumbull and Monroe.

18. TRANSPORTATION

The basin area is served by the New York, New Haven and Hartford Railroad, numerous motor common carriers, and a nearby municipal airport. A network of paved roads crisscrosses the basin, facilitating highway travel. A steamboat line from Port Jefferson, Long Island to Bridgeport provides passenger and freight service. Heavy shipping is handled at numerous dock facilities at Bridgeport harbor, a port for large ocean-going vessels.

Navigation on the Pequonnock River has been improved as a Federal project providing for a channel with a minimum depth of 18 feet and width of 125 feet, extending from the head of the Bridgeport Harbor main ship channel at the Connecticut Turnpike bridge up the tidal estuary to within 600 feet of the River Street bridge in Bridgeport. Controlling depths in the project are 35 feet in the main channel and 15 feet in the Pequonnock River channel, with the exception of a 13-foot depth through the East Washington Avenue draw passage.

19. TRENDS OF DEVELOPMENT

The Pequonnock River basin lies in the eastern part of Fairfield County, the most prosperous and fastest growing county in Connecticut. Served by the main line of the New Haven Railroad and a modern highway system and lying only 56 miles to the northeast of New York City, the basin area has shared in the county's growth. Trumbull, a town in the center of the basin, more than doubled its population in the decade 1950-1960. While Bridgeport proper lost slightly in population in the same decade (1.2 percent), following the nation-wide trend for large central cities, the basin portion of the city has experienced a growth in facilities which has completely built over the area in the basin below U. S. Route 1A. Over 20 percent of the usable flood plain in Trumbull is built over with housing; at the present rate the entire usable flood plain will be built over by 1970. In Bridgeport, most of

the flood plain is occupied by commercial and light industrial properties. In one area of about three blocks, some of the land is occupied by marginal type housing, mainly single units. The current prices and demand for land in this area are such that this land will undoubtedly change to commercial use by 1975.

SECTION VII - FLOOD DAMAGES

20. EXTENT AND CHARACTER OF FLOODED AREA

Over 340 acres of land are susceptible to flooding by the Pequonnock River between Daniels Farm Road in Trumbull, just below the proposed project, and Bridgeport Harbor. The upper reaches of the flood plain in Trumbull are residential in character. Some 50 dwellings, the majority less than 10 years old, would be damaged by floods of the magnitude of the October 1955 flood. The average value of these houses is in excess of \$25,000. Downstream of the Trumbull-Bridgeport line, the river flows through Beardsley Park, a large municipal park, to U.S. Route 1A north of the center of Bridgeport. Beyond Route 1A, the river flows through a completely built-over commercial and light industrial area to Bridgeport Harbor. A large shopping center, a twin drive-in theater, 27 small industrial plants and numerous small commercial enterprises occupy the flood plain in this zone. The shopping center, which contains 22 individual outlets, is of recent construction, the rest of the area is older.

21. RECURRING LOSSES

If the record flood of October 1955 were to recur under current economic and physical conditions, losses in the Pequonnock River basin would amount to \$1,454,000. Major losses would be incurred in the shopping center which would have over five feet of water in the parking areas, and there would be substantial damages to housing developments in Trumbull. Damages would also be suffered by 116 commercial and industrial establishments in Bridgeport. U. S. Route 1A and Connecticut Route 127 would be covered by over three feet of water cutting off access to Trumbull from the south.

22. ANNUAL LOSSES

Estimated recurring losses along the river were converted to average annual losses in accordance with standard Corps of Engineers procedures. Average annual losses amount to \$116,100 in the Pequonnock River basin below Daniels Farm Road in Trumbull.

23. FUTURE ANNUAL LOSSES

Full development of the flood plain in Trumbull will mean an increase in annual losses in that area of \$18,000 by 1970, at which time flood prevention projects might be expected to be in operation; therefore, no discounting of losses for the time lag is necessary. For the area in Bridgeport, where a change in use is projected, losses were increased by the difference between a unit square foot price for commercial losses and a unit square foot price for residential losses for the residential area involved, discounted for the assumed five-year time lag after 1970. Future annual losses in the basin amount to \$142,600 at the 1964 price level.

SECTION VIII - IMPROVEMENTS BY FEDERAL AGENCIES

24. CORPS OF ENGINEERS

There are no Corps of Engineers flood control projects on the Pequonnock River or its tributaries. The existing Federal navigation project in Bridgeport Harbor is described in paragraph 18.

25. SOIL CONSERVATION SERVICE

The Soil Conservation Service of the Department of Agriculture is delaying the initiation of a study of the Pequonnock River basin pending completion of the Corps of Engineers study and submission of this report.

SECTION IX - BASIN PROBLEMS

26. FLOOD CONTROL

The Pequonnock River basin is susceptible to floods caused by heavy rain or heavy rain and melting snow. Flood stages in the lower portions of Bridgeport are affected by tidal conditions in Long Island Sound.

All practicable methods of solving the flood problems were considered, including construction of reservoirs, protection by dikes and flood walls, channel relocation or enlargement, and flood plain zoning. The extent to which development has already taken place in the flood plain indicates that flood plain zoning would at best be an incomplete solution to the Pequonnock River basin flood problems. On a long

range basis, however, it would be of supplemental benefit to flood protection works.

Under existing legislation, the Water Resources Commission of the State has the authority and responsibility to establish river encroachment lines. The establishment of these lines where necessary to limit future building of any obstruction or other encroachment without permit would be of additional benefit.

27. RELATED WATER RESOURCES PROBLEMS

In planning for flood control in the Pequonnock River basin, consideration was given to all related water uses that might be affected by the plan or coordinated with the studied works. Related purposes, including water supply, recreation, fish and wildlife conservation and enhancement, low flow augmentation, and hydroelectric development, are discussed in the following subparagraphs.

a. Water supply.

(1) Existing system. The Pequonnock River basin lies entirely within the service area of one water supplier, the Bridgeport Hydraulic Company, an investor-owned company, which provides water for industrial and domestic users in the towns of Easton, Fairfield, Monroe, Shelton, Stratford, Trumbull, Weston, and Westport, and the city of Bridgeport, an area with a total 1960 population of about 317,500. In addition, the town of Redding, with 3,359, will probably be included in the service area before 1980. The company's system presently has a safe yield of 15 m. g. d. (million gallons per day) from ground water sources and 57.5 m. g. d. from surface sources. The demand for water in this service area, amounting to 54.7 m. g. d. in 1963, has increased in the past decade and a half at a rate of about 1.5 m. g. d. per year as a result of serving a larger population each year and a growing per capita consumption of water. While per capita consumption of water is not expected to increase at as great a rate in the future, the number of people served is expected to increase greatly as a result of population growth and because the company expects to serve an increasing percentage of the population in the service area, reaching 99 percent by the year 2020. Forty percent of the company's present demand is for industrial supply and this proportion is projected to continue in the future.

(2) Future water supply needs and availability. Considering the trend toward increasing population served by the Bridgeport Hydraulic Company, the Department of Health, Education, and Welfare estimates that water supply demand in the service area will exceed the available supply from the presently developed sources by 1975 and will double the present demand by the year 2000, when an additional 41.5 m. g. d. will be needed. New sources of supply for this area must therefore be developed in the immediate future.

The company is giving consideration to reconstruction of its former Trumbull Pond water supply reservoir on the Pequonnock River in Trumbull. Increased supplies may also be obtained from further development of the company's Housatonic well field, now producing about 12 m. g. d. The Bridgeport Hydraulic Company has conducted an extensive search for additional ground water supplies, but has so far been unsuccessful in locating any sizeable, new ground water sources.

b. Stream flow releases for low flow regulation. The portion of the Pequonnock River valley below the proposed project contains outstanding natural recreation features. Directly below the proposed damsite is a highly rugged and scenic gorge, an exceptional attraction in the southern portion of Connecticut. The gorge, owned by the Bridgeport Hydraulic Company, is open to the public and receives a high degree of leisure time use. The $4\frac{1}{2}$ miles of river between the proposed project and Bunnells Pond, along with the adjacent land area, is leased by the Connecticut Board of Fisheries as a public hunting and fishing area and is classified as excellent for "put and take" trout fishing and pheasant hunting.

The waters of the Pequonnock River downstream of the proposed project are of relatively good quality. There is no significant waste discharge into the river and there is no indication of potential industrial waste discharge developing in the drainage area.

Bunnells Pond, formed by a small dam on the Pequonnock River, is fifty-five acres in size. It is part of the city of Bridgeport's 250-acre Beardsley Park development which has facilities for swimming, sunbathing, and picnicking. This very attractive and well landscaped park is used intensively by the residents of Bridgeport.

However, need for water supply threatens these natural and man-made values. The Bridgeport Hydraulic Company will soon be forced to

draw on the Pequonnock River at the Trumbull Pond site, which is the last economically feasible site for development of a surface water supply within the company's service area around Bridgeport. The company will probably either participate with the Federal Government in the recommended multiple-purpose project or construct its own single-purpose reservoir if the multiple-purpose project is not constructed. Since the company owns complete water rights to the flow of the river, it cannot always be expected to provide normal downstream flow from this site in periods of short supply. The only other sources of flow in the downstream area are from a few seasonal tributary streams and flows from Pinewood Lake, which would probably be withheld in summer months.

Unless storage for stream flow release is provided in the recommended project, the effects on the downstream area could be severe, with river flows reduced up to 80 percent. The 4½ miles of trout stream between the recommended project and Bunnells Pond would be depleted due to drying up of a major portion of the river and warming of any remaining water. Summer use of Bunnells Pond would present a hazard to public health because of low flows and high temperatures combined with the increased desire of the public to swim at this season.

It is concluded that some storage for low flow release is necessary in conjunction with the water supply storage to prevent substantial loss of public use of the Pequonnock River below the Trumbull project due to decreased aesthetic values of the river, partial or complete depletion of the existing trout fishery, and harmful effects on the public swimming facility at Bunnells Pond.

Stream releases are not considered necessary for waste dilution since there are at present no important waste discharges to the Pequonnock River. Plans for a future sewage system in Trumbull will require that an outfall line be constructed to discharge into the river downstream of Beardsley Park and only a short distance above the river mouth. In its report, the U. S. Public Health Service of the Department of Health, Education and Welfare concludes: "Water storage to provide dilution of treated municipal and industrial wastes in the Pequonnock River basin is not presently needed, nor will it be needed in the future..."

Additional storage in the project to augment low stream flows would realize further benefits from an increase in existing recreational and fishery uses and improvement of aesthetic values downstream.

c. Recreation. "The demand for outdoor recreation is surging. Whatever the measuring rod, it is clear that Americans are seeking the outdoors as never before. And this is only a foretaste of what is to come. Not only will there be many more people, they will do more, and they will have more money and time to do it with. By 2000, the population should double; the demand for recreation will triple," reports the Outdoor Recreation Resources Review Commission. There are, at present, over one million people now living within a 25-mile radius of the Trumbull Pond damsite. The 10 existing state parks and forests in this area are unable to meet the recreation needs of this high population density as augmented by a large tourist and summer resident influx.

d. Power development. Some of the falls in the river have been utilized over the years for water power. Although small amounts of power might now be developed at a few locations in the basin, the Federal Power Commission finds that it would not be practicable nor economically feasible to do so.

SECTION X - IMPROVEMENTS CONSIDERED

28. GENERAL

Studies for this report, considering the needs for flood control and basin water resources development on the Pequonnock River, found four alternative projects physically feasible: a four-purpose dam and reservoir for flood control, water supply, low flow augmentation, and recreation; a three-purpose dam and reservoir at the same site, for flood control, low flow augmentation, and recreation; local protection works along the Pequonnock River downstream of Bunnells Pond and along the Island Brook tributary; and less extensive local protection works along the Pequonnock River.

Neither of the two considered local protection projects proved to be economically justified at this time. Although the three-purpose project dam and reservoir (without water supply) is equally as justified as the four-purpose project (with water supply), the ability of the site to economically fulfill the water supply function and the expressed interest of the water supplier in the area dictated the selection of the four-purpose project.

draw on the Pequonnock River at the Trumbull Pond site, which is the last economically feasible site for development of a surface water supply within the company's service area around Bridgeport. The company will probably either participate with the Federal Government in the recommended multiple-purpose project or construct its own single-purpose reservoir if the multiple-purpose project is not constructed. Since the company owns complete water rights to the flow of the river, it cannot always be expected to provide normal downstream flow from this site in periods of short supply. The only other sources of flow in the downstream area are from a few seasonal tributary streams and flows from Pinewood Lake, which would probably be withheld in summer months.

Unless storage for stream flow release is provided in the recommended project, the effects on the downstream area could be severe, with river flows reduced up to 80 percent. The $4\frac{1}{2}$ miles of trout stream between the recommended project and Bunnells Pond would be depleted due to drying up of a major portion of the river and warming of any remaining water. Summer use of Bunnells Pond would present a hazard to public health because of low flows and high temperatures combined with the increased desire of the public to swim at this season.

In its report, the Public Health Service finds that, during periods of low flow, the natural runoff would be cut off by the proposed project. This would result in deterioration of water quality as well as reduce streamflow below the level necessary to maintain a suitable fish and wildlife habitat. Damages to water quality would include, but not be limited to, reduced dissolved oxygen levels, higher water temperatures, and the build-up of algae and bacteria, all of which would diminish the aesthetic character and beneficial uses of the river.

The Service concludes that additional streamflow will be needed to control the effects of land drainage and urban runoff as the area becomes increasingly urbanized. Storage requirements for the project, however, cannot be ascertained until data are available from comprehensive water pollution control studies presently under way in the region.

It is concluded that storage for water quality control is necessary in conjunction with the water supply storage to prevent substantial loss of public use of the Pequonnock River below the Trumbull project due to decreased aesthetic values of the river, partial or complete depletion of the existing trout fishery, and harmful effects on the public swimming facility at Bunnells Pond.

c. Recreation. "The demand for outdoor recreation is surging. Whatever the measuring rod, it is clear that Americans are seeking the outdoors as never before. And this is only a foretaste of what is to come. Not only will there be many more people, they will do more, and they will have more money and time to do it with. By 2000, the population should double; the demand for recreation will triple," reports the Outdoor Recreation Resources Review Commission. There are, at present, over one million people now living within a 25-mile radius of the Trumbull Pond damsite. The 10 existing state parks and forests in this area are unable to meet the recreation needs of this high population density as augmented by a large tourist and summer resident influx.

d. Power development. Some of the falls in the river have been utilized over the years for water power. Although small amounts of power might now be developed at a few locations in the basin, the Federal Power Commission finds that it would not be practicable nor economically feasible to do so.

SECTION X - IMPROVEMENTS CONSIDERED

28. GENERAL

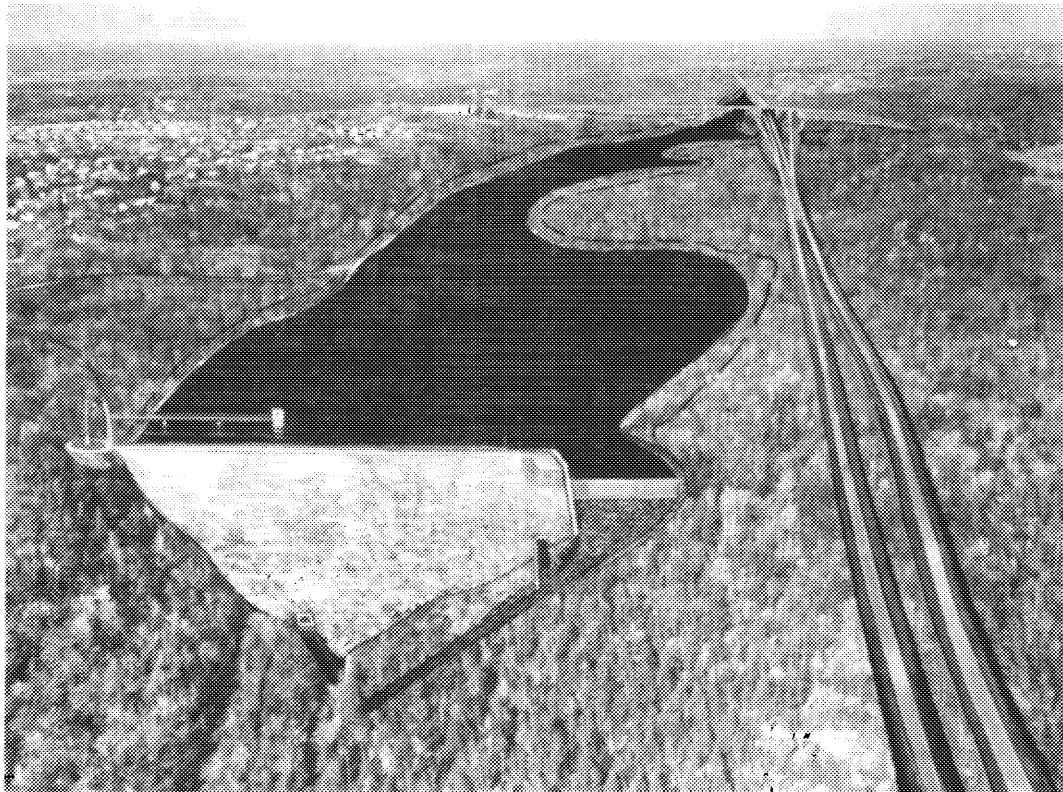
Studies for this report, considering the needs for flood control and basin water resources development on the Pequonnock River, found four alternative projects physically feasible: a four-purpose dam and reservoir for flood control, water supply, water quality control, and recreation; a three-purpose dam and reservoir at the same site, for flood control, water quality control, and recreation; local protection works along the Pequonnock River downstream of Bunnells Pond and along the Island Brook tributary; and less extensive local protection works along the Pequonnock River.

Neither of the two considered local protection projects proved to be economically justified at this time. Although the three-purpose project dam and reservoir (without water supply) is equally as justified as the four-purpose project (with water supply), the ability of the site to economically fulfill the water supply function and the expressed interest of the water supplier in the area dictated the selection of the four-purpose project.

It is considered that this project best satisfies the varied demands for water use in the basin. A description of the proposed project is given in the following paragraphs.

29. TRUMBULL POND DAM AND RESERVOIR

a. Description. The proposed dam and reservoir would be located on the Pequonnock River in Trumbull at the site of the former Trumbull Pond water supply reservoir of the Bridgeport Hydraulic Company, approximately 6 miles above the River Street bridge in Bridgeport. The dam would be of rolled earth fill with a length of about 750 feet and top at elevation 285 feet m. s. l. (mean sea level), or 129 feet above stream bed. A chute spillway, 200 feet long, would be located in the east abutment.



Artist's Conception of Trumbull Pond Dam and Reservoir
(Proposed Route 25 relocation to right, Whitney Avenue in background)

At spillway crest elevation 270 feet m.s.l., the reservoir would extend about 2.5 miles upstream of the dam and provide a total storage capacity of 13,780 acre-feet, of which 5,980 would be for flood control storage, 5,850 for water supply, 1,350 for augmenting existing stream flow, and 600 for sediment storage. With the drainage area totaling 14 square miles, including the 3.9 square miles of an intermittent diversion from the West Branch, the flood control storage would be equivalent to 8 inches of runoff. A 900-foot long dike at the upstream end of the reservoir would be required to protect the relocated Route 25 proposed by the State of Connecticut. A reservoir map is shown on Plate 2; a general plan of the dam and appurtenant structures is shown on Plate 3.

b. Flood Control.

(1) Reservoir regulation. Regulation of flood control storage in Trumbull Pond Reservoir would be automatic by means of an ungated outlet at elevation 244, reducing all floods on the Pequonnock River through Trumbull and Bridgeport. In a recurrence of the record flood of October 1955, the peak discharge would be reduced from the 4,110 c.f.s. to about 450 c.f.s. at Trumbull and from 5,800 c.f.s. to 3,600 c.f.s. at the Boston Avenue bridge in Bridgeport. The standard project flood would be reduced from 16,100 c.f.s. to 7,700 c.f.s. at the Boston Avenue bridge.

(2) Degree of protection. The reservoir would have sufficient flood control storage capacity to store a recurrence of the maximum flood of this century in the basin, that of October 1955. If a flood equal to the standard project flood should occur, the spillway would operate, but its discharge would be desynchronized with other downstream flows and the flood peak would be reduced by about one-half.

c. Water supply. The full water supply pool at elevation 237 feet m.s.l. would store 1.9 billion gallons and would cover 178 acres. The dead storage pool would provide space for any sediment which might collect in the reservoir. The project land and areas immediately adjacent to it are undeveloped and are owned by the Bridgeport Hydraulic Company, which also owns riparian water rights to the total flow of the river at the site. The water supply outlet works would consist of a twin-chambered intake tower housing multiple intake gates. The lowest intake would also permit emptying the reservoir. Discharge may be made independently from each chamber through two 30-inch conduits passing under the dam to a gated outfall structure. Flows may then pass into the water supply system or be diverted for low flow release, as desired.

The capacity for the recommended water supply pool was established as the reasonable amount of storage which would supply 9 million gallons daily with some reserve. The year of expected first use of the water supply is 1975, or five years after the assumed date of completion of the project.

d. Water quality control. Downstream from the recommended project, the Pequonnock River valley now provides excellent recreational facilities and opportunities: swimming, sunbathing, and picnicking at Bunnells Pond in Bridgeport's Beardsley Park and "put and take" pheasant hunting and trout fishing along the reach between the park and the project. This is an area of natural habitat for fish and wildlife indigenous to the region, managed by the Connecticut Board of Fisheries and Game, which leases and stocks the land and river.

The minimum storage required to maintain present natural conditions of flow is estimated at 260 acre-feet. However, the resources of the Pequonnock River can be more fully developed and enhanced by providing a greater amount of storage. The Fish and Wildlife Service of the U. S. Department of Interior recommends 3 cubic feet per second of stream flow at all times to produce the desired amount and thermal quality of water. To maintain this flow during critical low flow periods would require a total storage of 1,350 acre-feet. The reservoir, at full storage capacity for water supply and water quality control, would be at elevation 244 feet, msl, and extend upstream about 2.1 miles with a surface area of 198 acres.

Releases from this storage of 1,350 acre-feet would be adequate to support a permanent trout stream habitat, according to the Fish and Wildlife Service and the Connecticut Board of Fisheries and Game. The Service estimates that additional benefits to the fisheries resources of the river and Beardsley Park Pond would result.

The Public Health Service, while recognizing the need for storage for water quality control, indicates that information and data which will make possible a determination of required water storage for water quality control purposes will not be available until the time of design studies. For the purpose of this report, it is assumed that the 1,350 acre-feet of storage for enhancing the fishery resource is also adequate for water quality control purposes.

e. Recreational development.

(1) General. Excellent recreational opportunities could be provided by the Trumbull Pond project with recreational development included as a project purpose. The project is located in an area of unspoiled scenic beauty, unusual for this highly-developed region of Connecticut. A natural gorge in the river valley immediately below the damsite presents steep, rugged, and wooded valley walls. The unspoiled terrain and rugged scenery of the area

and the interest attaching to the dam and associated works would attract sightseers and picnickers. The proximity of major interstate highways would assure full use. The permanent pool would provide scenic beauty and opportunity for limited, water-based recreation, including boating and fishing. The Bridgeport Hydraulic Company, in indicating interest in the water supply aspects of the project, also indicated that such associated uses would be permitted. Under Connecticut statutes, bathing or swimming, however, is prohibited in water supply reservoirs.

(2) Recreational facilities. The recreation area would be developed in 6 acres of project land located above spillway crest on the southwestern edge of the reservoir adjacent to the damsite. Development would include a picnic site with tables and benches, parking areas, overlook sites, hiking trails, comfort stations, a shelter facility, and access roads for the general public. A boat launching area would be located at the upper end of the reservoir. Recreational development would be limited by the restrictions pertaining to permitted uses of water supply reservoirs. Limited use of land below spillway crest elevation would be allowed if compatible with the flood control and water supply features of the reservoir. The expected visitor-day attendance would be 50,000 per year, including 20,000 sightseers and 30,000 visitors to the picnic areas.

(3) Access. To use the project area, out-of-town visitors coming from Bridgeport via Route 25 (as relocated) would take an "off" ramp at Whitney Avenue (as relocated) and skirt the project area on Route 127 and old Route 25 to reach the access road. Those returning by way of Bridgeport would have an access to the southbound lane of Route 25 at the Whitney Avenue interchange. Visitors coming via 25 from the north would exit from and re-enter the highway by one of the other nearby interchanges.

SECTION XI - FIRST COSTS AND ANNUAL CHARGES

30. FIRST COSTS

In the estimate of construction and relocation costs, unit prices are based on average bid prices for similar work in the same general region. The adopted unit prices are adjusted to current price levels and include allowances for contingencies. Valuation of property, based on the Market Data Approach, reflects recent sale values in the area. Land costs are based on the estimated fee value. The costs for engineering and overhead are based on knowledge of the

site and experience on similar projects. Investment costs include interest during construction of 3-1/8 percent for one-half the estimated construction period of 2 years. A summary of first costs of the proposed project is given in Table I.

The estimate of costs is based on the assumption that the State will construct the new highway (a relocation of present Route 25) along the eastern side of the project area and relocate Whitney Avenue, all substantially as shown on Plate 2, prior to construction of the reservoir project. Under this assumption, the cost of the reservoir project includes construction of a dike at the upper end of the reservoir to protect the highway, and severance costs for land which will be between the reservoir and the highway.

31. ANNUAL CHARGES

Average annual costs are based on an annual interest rate of 3-1/8 percent. Annual costs include all anticipated charges for project maintenance, operation, and major replacements, interest on the project investment and costs of amortizing the project investment over the 100-year assumed economic life of the project, and loss of taxes on land required for the project. Annual charges are summarized in Table I.

SECTION XII - BENEFITS

32. FLOOD CONTROL BENEFITS

a. Flood damage prevention. Average annual flood damage prevention benefits from the Trumbull Pond Dam and Reservoir are computed at \$100,700 at the 1964 price level. This amount is derived as the difference between the annual losses expected to prevail in the basin in 1970 and the average annual losses remaining after construction of the project, and includes benefits, based on expected growth, amounting to \$15,000 in Trumbull and \$5,700 in Bridgeport. In deriving growth benefits, annual losses in Trumbull were increased by the ratio of total usable land area to present land area used. Annual losses in Bridgeport were increased by the difference between the unit square foot price for commercial losses and the unit square foot price for residential losses multiplied by the square feet of residential area involved. This increase was then discounted at 3-1/8 percent for the 5-year lag in time expected between the completion of the project and the date when change in

TABLE I
TRUMBULL POND DAM AND RESERVOIR
FIRST COSTS AND ANNUAL CHARGES
 (1965 Price Level)

FIRST COSTS

Lands and damages	\$ 935,000
Reservoir	100,000
Dam	3,020,000
Recreation facilities	40,000
Engineering and design	500,000
Supervision and administration	<u>405,000</u>
Total estimated First Costs	\$5,000,000
Interest during construction	<u>156,000</u>
Total Project Investment	\$5,156,000

ANNUAL CHARGES

Interest	\$ 161,100
Amortization	7,800
Operation and maintenance	23,000
Major replacements	<u>4,600</u>
Total Financial Annual Charges	\$ 196,500
Loss of taxes	<u>13,800</u>
Total Economic Annual Charges	\$ 210,300

land use will be completed. Additional growth after 1975 is not included since it is anticipated the flood plain area will be fully utilized by that time.

b. Enhancement. Flood stage reductions effected by the recommended reservoir would, in time, encourage higher utilization of downstream lands and buildings. The degree and form of such utilization, however, is conjectural and no higher utilization or enhancement benefits have been assigned to the project.

c. Intangible benefits. Important intangible benefits to the general welfare and security of the people, which cannot be measured in monetary terms, would be realized from stage reductions effected by the project. The threat of loss of life or of physical injury, and the potential danger of disease arising from polluted floodwaters would be greatly reduced.

33. WATER SUPPLY BENEFITS

Annual benefits of \$120,000, attributable to water supply storage in the multiple-purpose project, were derived on the basis of the annual charges for the most likely, least costly alternative for such supply. Two alternatives are available to provide the same municipal and industrial water supply as the multiple-purpose Trumbull Pond project. One alternative would be construction of additional pumping facilities and pipeline from the Housatonic River well field of the Bridgeport Hydraulic Company. The other would be construction of a single-purpose, water supply reservoir at the Trumbull Pond site. Studies by the Public Health Service of the U. S. Department of Health, Education and Welfare indicate that the least costly way to obtain the same benefits and, therefore, the "most likely" alternative would be the construction of a single-purpose water supply dam and reservoir.

34. FISH AND WILDLIFE BENEFITS

The Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Department of the Interior, has prepared a report on the fish and wildlife resources related to the Trumbull Pond Dam and Reservoir in cooperation with the Connecticut State Board of Fisheries and Game. A summary of their findings is given below.

a. Fishery resources. The multiple-purpose project would provide a cold-water lake fishery, the only such fishery within a 20-mile radius. The reservoir would be stocked with catchable trout by the State of Connecticut since free public access would be provided. It is estimated that the average annual fishing pressure over the 100-year project life will be about 42,000 man-days, an increase of 40,300 over pre-project conditions. Downstream of the project, augmentation of low flows would permit 8,400 man-days of fishing annually, an increase of 5,600 man-days. Low flow releases are also expected to change the fishery habitat of Bunnells Pond from a warm-water habitat to a marginal cold-water habitat capable of supporting an average annual fishing pressure of 9,800 man-days, an increase of 8,400 over existing conditions.

The net increase in fishery benefits creditable to the proposed project is 40,300 man-days of lake fishing in the reservoir and 14,000 man-days of fishing downstream of the project. Annual values of these benefits as estimated by the Fish and Wildlife Service, are \$161,000 and \$49,000 respectively.

b. Wildlife resources. Pheasant is the most important game species in the project area and receives heavy hunting pressure. The hunting is maintained by put-and-take stocking by the State at an annual rate of about 200 birds. The principal pheasant habitat is in that portion of the valley which will be inundated by the proposed project or the single-purpose water supply project which will be built by private interests if the multiple-purpose project is not constructed. The pheasant-hunting opportunities will therefore be totally lost either with or without the Federal project.

35. WATER QUALITY CONTROL

a. Tangible benefits. As noted above, the U. S. Fish and Wildlife Service estimates that benefits of \$49,000 would accrue to downstream fisheries as a result of low flow releases. Although these benefits are part of the over-all fish and wildlife benefits accruing to the project, they have been segregated and considered as water quality control benefits in order to properly evaluate the economic justification for including storage for this purpose. Additional tangible benefits are not determined at this time by the Public Health Service although it considers that water quality control should be included as a project purpose to which benefits will be ascribed when quality needs are more adequately defined by comprehensive water pollution control studies now under way.

b. Intangible benefits. Water quality control also provides real, although intangible, benefits to recreation, public health, and the aesthetic character of the area.

36. RECREATION BENEFITS

General recreational use of the project would amount to an estimated 50,000 visitor-days annually, consisting of 20,000 sightseers and 30,000 visitors to the picnic area development, resulting in annual benefits of \$15,000.

37. TOTAL ANNUAL BENEFITS

Annual benefits accruing to all purposes in the Trumbull Pond Dam and Reservoir would total \$445,700. Table II summarizes benefits accruing to the project.

TABLE II
ANNUAL BENEFITS
TRUMBULL POND DAM AND RESERVOIR

<u>Benefit</u>	<u>Amount</u>
Flood control	\$100,700
Water supply	120,000
Recreation	15,000
Fish and wildlife	161,000
Water quality control	<u>49,000(1)</u>
Totals	\$445,700

(1) Benefits to downstream fishery only; additional benefits anticipated by Public Health Service

SECTION XIII - ALLOCATION OF COSTS AMONG PURPOSES

38. GENERAL

Costs to the several project purposes were allocated by the "Separable Costs-Remaining Benefits" method. Under this method, each purpose is first allocated its separable cost (the cost directly traceable to its inclusion in the multiple-purpose project). The joint costs (costs remaining after all separable costs are deducted from the total cost) are then allocated by distribution among the project purposes in proportion to the excess of benefits over separable costs estimated for each purpose. This method assures that all purposes served by the project share equitably in the benefits of multiple-purpose construction. Table III summarizes the

results of the allocation for the proposed project. The total investment is the first cost plus interest during construction.

TABLE III
SUMMARY OF ALLOCATION OF COSTS

<u>Purpose</u>	<u>First Cost</u>	<u>Investment</u>	<u>Annual Charges</u>
Flood control	\$1,929,000	\$1,988,000	\$ 74,800
Water supply	2,475,000	2,554,000	105,900
Recreation(1)	143,000	147,000	11,900
Water quality(2)	453,000	467,000	17,700
Totals	\$5,000,000	\$5,156,000	\$210,300

(1) Based on benefits to general recreation and reservoir fishing.

(2) Based on benefits to downstream fishing.

SECTION XIV - PROJECT FORMULATION

39. COMPARISON OF BENEFITS AND COSTS

A comparison of benefits accruing to each project purpose with the costs allocated to the respective purpose indicates that each project purpose is amply justified as summarized in Table IV. The overall benefit-cost ratio is 2.1 to 1.

TABLE IV
ECONOMIC ANALYSIS

<u>Purpose</u>	<u>Annual Benefits</u>	<u>Annual Costs</u>	<u>Benefit: Cost Ratio</u>
Flood control	\$100,700	\$ 74,800	1.4
Water supply	120,000	105,900	1.1
Recreation	176,000(1)	11,900	14.8
Water quality	49,000	17,700	2.8
Totals	\$445,700	\$210,300	2.1

(1) Includes benefits to general recreation and to reservoir fishing.

(2) Includes benefits to fishery only; additional benefits are anticipated.

SECTION XV - APPORTIONMENT OF COSTS AMONG INTERESTS

40. FLOOD CONTROL

Flood control benefits which would be realized from construction of the selected project will be wide-spread. The costs allocated to flood control are therefore considered to be all Federal.

41. WATER SUPPLY

Costs of the proposed project allocated to water supply will be reimbursable under the provisions of the Water Supply Act of 1958, as amended. The Bridgeport Hydraulic Company, which owns most of the reservoir lands and the downstream water rights, has indicated its interest in participating in the project. The Act also stipulates that the costs allocated to anticipated future demands may not exceed 30 percent of the total estimated cost of the project. Total costs of the selected project allocated to water supply are \$2,475,000 of which \$975,000 may be attributed to water supply for immediate use and \$1,500,000 to future use. This amounts to 19.5 percent and 30 percent respectively of the total estimated project cost.

42. RECREATION

a. General criteria. Cost sharing for those portions of the project costs assigned to recreation, including fish and wildlife enhancement, has been made in accord with the policy set forth in House Resolution 9032 introduced on 6 November 1963. This resolution provides that the construction costs of project lands and facilities allocated to recreation and fish and wildlife enhancement in water resource projects will be borne as stated below:

(1) The separable construction costs will be non-reimbursable and assigned to the Federal Government in the sum of:

(a) The specific costs incurred initially for land and basic facilities for recreation or fish and wildlife enhancement.

(b) Other costs for lands and facilities included in the separable costs allocated to recreation and fish and wildlife enhancement, in the aggregate, up to a limit of 25 percent of the first costs of joint-use facilities, or \$5,000,000, whichever is less.

(2) Joint construction costs of lands and facilities allocated to recreation and fish and wildlife enhancement shall, in the aggregate, be non-reimbursable and assigned to the Federal Government up to a limit of 25 percent of the costs of joint-use land and facilities where such joint-use costs are not over \$10,000,000.

b. Cost-sharing for selected project. Under the criteria established by H. R. 9032, the limit on "other costs" and "joint costs" for the selected project are each \$1,041,000 (25 percent of total joint-use costs). "Other costs" and "joint costs" allocated to recreation and fish and wildlife enhancement are, respectively, 0 and \$93,000 for the selected project. All costs allocated to recreation, including fish and wildlife enhancement, are therefore non-reimbursable and assigned to the Federal Government under this criteria.

c. Cost-sharing under H. R. 5269. Subsequent to completion of studies for this report, policies and procedures with respect to division of responsibility between Federal and non-Federal interests regarding recreation and fish and wildlife enhancement features of Federal multiple-purpose reservoirs have been in a continuing state of transition. The policies and procedures set forth in House of Representatives Bill Numbered 9032 were a part of this transition. The Congress did not act on H. R. 9032. In the most recent action on this matter, proposed legislation was introduced, with Administration sponsorship, as House of Representatives Bill Numbered 5269, 89th Congress, First Session, cited as the "Federal Water Project Recreation Act." The Bureau of the Budget has advised that it expects the agencies concerned to implement immediately the policies and procedures set forth in the proposed Act.

Fundamentally, the proposed Act provides for a substantial level of Federal participation in the cost of development for recreation and fish and wildlife enhancement at projects such as the Trumbull Pond Dam and Reservoir if non-Federal interests agree to administer project land and water areas for these purposes, bear not less than one-half of the separable project costs allocated thereto, and bear all the costs of operation, maintenance, and replacement of lands and facilities for recreation and fish and wildlife enhancement. The proposed Act includes provisions responsive to problems of adjustment to a new policy in the case of projects for which preauthorization planning is well advanced, and for adoption of plans to reflect the intentions of non-Federal interests with respect to participation in the cost of recreation and fish and wildlife enhancement activities at various stages of project planning and implementation.

On the basis of the Administration's position, local interests would be required to:

(1) Administer project land and water areas for recreation and fish and wildlife enhancement;

(2) Pay, contribute in kind, or repay (which may be through user fees), with interest, one-half of the separable cost of the project allocated to recreation and fish and wildlife enhancement, an amount currently estimated at \$25,000 based on the presently planned level of development for these purposes; and

(3) Bear all costs of operation, maintenance, and replacement of lands and facilities for recreation and fish and wildlife enhancement, an amount currently estimated at \$4,700 on an average annual basis.

43. WATER QUALITY CONTROL

Storage for water quality control, as previously noted, would enhance the fishery resources of the Pequonnock River in the reach of river immediately downstream from the project and in Bunnells pond. Additional benefits to water quality control, while substantial, cannot be determined at this time. Since the benefits are widespread, all costs are considered to be Federal.

44. SUMMARY OF APPORTIONMENT AMONG INTERESTS

Under the provisions of the policies expressed in the Water Supply Act of 1958, as amended, and H. R. 9032, \$2,525,000 (50.5 percent) of the total project first cost is assignable to the Federal Government and \$2,475,000 (49.5 percent) is reimbursable and chargeable to local interests. Under the provisions of the cited Act and H. R. 5269, \$2,500,000 (50.0 percent) of the project first cost would be assigned to the Federal Government and \$2,500,000 (50.0 percent) would be reimbursable and chargeable to local interests.

SECTION XVI - PROPOSED LOCAL COOPERATION

45. WATER SUPPLY

a. General requirements.

Local participation in the cost of the selected multiple-purpose dam and reservoir would include repayment of costs allocated to water supply under the provisions of the Water Supply Act of 1958, as amended.

Under the provisions of this law, local interests shall enter into an agreement to pay for the cost of including water supply provisions. The law provides further that (1) not to exceed 30 percent of the total estimated cost of the project may be allocated to future water supply storage; and (2) local interests must give reasonable assurances that they will contract for the use of the storage for anticipated future water demands within a period of time which will permit paying out the costs allocated to water supply within the life of the project.

Water rights for the use of the stored water will be obtained as necessary by the water users. The local interests contracting for the use of the water supply storage will also be required to hold the Federal Government harmless from liability for or on account of any claim for damages which may be made or asserted as the result of the storage and withdrawal of water by the user and they will be required to use the water in a manner consistent with Federal and State laws.

b. Proposed repayment.

(1) Prior to initiation of construction of the reservoir for flood control, water supply, low flow augmentation, and recreation, local interests would be required to enter into a contract with the United States to provide that the entire amount of the construction costs, including interest during construction, allocated to water supply shall be repaid within the life of the project but in no event to exceed fifty years after the project is first used for the storage of water for water supply purposes, except that (1) no payment need be made with respect to storage for future water supply until such supply is first used, and (2) no interest shall be charged on such cost until such supply is first used, but in no case shall the interest-free period exceed ten years. Local interests would also be required to share equitably in the annual costs of maintenance, operation, and major replacements.

(2) The interest rate used for purposes of computing interest during construction and interest on the unpaid balance will be determined by the Secretary of the Treasury, as of the beginning of the fiscal year in which construction is initiated, on the basis of the computed average interest rate payable by the Treasury upon its outstanding marketable public obligations, which are neither due nor callable for redemption for fifteen years from date of issue.

(3) For the selected Trumbull Pond project, maximum costs, including interest during construction, which may be allocated to future water supply are limited by law to 30 percent of the total project investment, an amount currently estimated at \$1,547,000. Additional costs allocated to water supply, or 19.5 percent of the total project investment, currently estimated at \$1,007,000, must be, and are, assigned to water supply for immediate use. Annual costs allocated to water supply for maintenance, operation, and major replacements are currently estimated at \$17,700.

46. RECREATION

Under the provisions of H. R. 5269, local interests would be required to share in the first costs and to maintain the project for recreation and fish and wildlife enhancement as outlined in paragraph 42c.

47. ENCROACHMENT LINES

In addition to assuming costs allocated to water supply, local interests would be required to establish river encroachment lines along the channel downstream from the dam to prevent encroachment which would hinder reasonable, efficient reservoir operation. The State of Connecticut is empowered to establish such encroachment lines.

SECTION XVII - COORDINATION WITH OTHER AGENCIES

48. GENERAL

Water resource development plans for the Pequonnock River basin have been reviewed by Federal, State, and local agencies, including the Public Health Service of the U. S. Department of Health, Education, and Welfare, the Fish and Wildlife Service of the U. S. Department of the Interior, the Connecticut State Water

Resources Commission, officials of the town of Trumbull, and representatives of the Bridgeport Hydraulic Company.

The Department of Health, Education, and Welfare prepared a study on the present and future requirements for water supply for domestic and industrial use, and for water quality control. The findings of the Department confirmed the request of the Bridgeport Hydraulic Company relative to the need and the amount of storage required for water supply purposes. The Bureau of Sport Fisheries, Fish and Wildlife Service, Department of the Interior, prepared and submitted estimates of benefits to fish and wildlife accruing to the project and generally approves the report as it affects fish and wildlife conservation and enhancement.

Results of studies for this report will be made available to the Soil Conservation Service of the Department of Agriculture which is delaying initiation of a study of the basin pending completion of this report.

49. PUBLIC HEARING

A public hearing was held in Trumbull, Connecticut on 8 December 1964 to present the selected Trumbull Pond Dam and Reservoir project and to obtain the views of interested parties on this and any other proposals with respect to flood control and allied matters in the Pequonnock River basin. Approximately 125 people attended the hearing, including representatives of Federal, State, and local governments; the water supply company; and industrial, commercial, and civic groups and interested individuals. The great majority of those expressing opinions favored the selected Trumbull Pond project. The First Selectman of Trumbull and two other speakers suggested that plans include construction of a road along the top of the dam to facilitate cross-town travel. (Subsequent correspondence with the Town relative to this item indicated a desire to defer a decision until after project authorization.) There was also support for a project without water supply which would permit unlimited recreational use.

SECTION XVIII - DISCUSSION

50. BASIN PROBLEMS

a. Flood control. The Pequonnock River basin has experienced five major floods in the past 30 years, with the most recent and most damaging occurring in October 1955. A recurrence of a flood of that magnitude with today's developments in the flood plain would cause

damages of \$1,454,000. Average annual flood losses, including losses for expected future growth and change in land use, are estimated at \$142,600.

b. Water supply. Requirements for water supply for municipal and industrial use are growing at a rate which indicates that presently developed supplies must be expanded prior to 1975.

c. Recreation. There is a scarcity of water-based recreational facilities available to the general public in the area. Sites for water-based recreation are limited, but the demand for such recreation continues to increase. The selected project site is located in the fastest growing county in the State with 400,000 people residing within a 10-mile radius, and one million people within a 25-mile radius.

d. Water quality control. The fresh water fishery resource of the Pequonnock River immediately below the selected damsite could be enhanced by increasing the river flow during periods of low discharge. Improved water quality will also provide increased downstream recreational opportunities, dilution of undesirable urban runoff, and intangible benefits which have real value in satisfying human desires.

51. SOLUTIONS CONSIDERED

a. Local protection projects. Local protection projects, consisting of channel improvement, dikes and flood walls, and necessary appurtenant structures are possible solutions to the present flood problems in the Pequonnock River basin. However, none of the studied projects is economically feasible at this time. Further, construction of local protection projects would not resolve other pressing basin needs.

b. Dams and reservoirs. The only economically feasible site for a dam and reservoir is at the location of the former Trumbull Pond water supply reservoir. A project at this site could provide storage for flood control, water supply, and recreation including enhancement of the existing fishery resources.

The project would create a 198-acre reservoir providing an easily accessible cold-water fishery habitat, the only cold-water lake fishery within a 20-mile radius. The Connecticut Board of Fisheries and Game indicates that it would stock the reservoir with legal size trout. With storage of water for water supply included

in the project, recreational use would be limited to fishing, boating, and picnicking. The project would also contain storage of water for release during low flow periods for preservation and enhancement of the downstream fishery resource and for abatement of pollution due to urban runoff.

52. SELECTED PLAN OF DEVELOPMENT

The selected plan of improvement, consisting of a multiple-purpose dam and reservoir at the Trumbull site is economically feasible with a benefit-cost ratio of 2.1 to 1. The benefits accruing to each project purpose exceed the costs allocated to that purpose. The Federal Power Commission concludes, from its study, that development of hydroelectric power in conjunction with the other project purposes is not warranted.

Additional information on the recommended and alternative projects, called for by Senate Resolution 148, 85th Congress, adopted 28 January 1958, is contained in Attachment 1 to this report.

SECTION XIX - CONCLUSIONS AND RECOMMENDATIONS

53. CONCLUSIONS

Studies for this report conclude that the most efficient way to reduce flood losses and develop the water resources in the Pequonnock River basin is by construction of a multiple-purpose dam and reservoir in Trumbull for flood control, water supply, water quality control, and recreational purposes, essentially as described in this report. Flood losses in a recurrence of the flood levels of 1955 in the basin would total \$1,454,000 under today's economic conditions. The Trumbull Pond dam would reduce this loss to less than \$400,000.

Future needs for additional sources of water supply in the basin can be partially satisfied by including storage for this purpose. Storage for water quality control will enhance the existing downstream fishery resource and public recreation at Bunnells Pond and will permit dilution of pollution caused by urban runoff. The project will also provide important, though limited, recreational opportunities in the reservoir area which are compatible with the water supply use. Provision of storage and facilities for each of these purposes is feasible and economically justified. The project has an overall benefit-cost ratio of 2.1 to 1.

54. RECOMMENDATIONS

It is recommended that the construction of a dam and reservoir on the Pequonnock River at Trumbull, Connecticut be authorized for flood control, water supply, water quality control, and recreation, essentially as described in this report, at a total estimated first cost of \$5,000,000 and estimated annual costs of \$27,600, for maintenance, operation and major replacements, provided that, within six months after being notified by the Chief of Engineers, responsible non-Federal interests shall furnish assurances satisfactory to the Secretary of the Army that they will enter into a contract with the United States for:

(a) Reimbursement to the United States of that portion of the construction costs allocated to future water supply, amounting to 30 percent of the total first cost of the project (presently estimated at \$1,500,000) plus interest during construction on this amount. This reimbursement shall be made within the life of the project but in no event shall the repayment period exceed 50 years after the project is first used for future water supply purposes, except that no payment need be made on this amount or interest charged thereon until storage is first used for future water supply purposes, but in no event shall the interest-free period exceed 10 years;

(b) Payment to the United States of the portion of the construction costs allocated to water supply for immediate use (presently estimated at \$975,000 or 19.5 percent of the total first cost of the project), such payment to be made either at the time of construction of the project or on an annual basis within a period of 50 years, provided that such annual payments shall begin when the project is first available for storage of water for water supply purposes and shall provide for repayment of the principal, plus interest thereon during construction, and interest on any unpaid portion of the total amount;

(c) Payment to the United States of the portion of the costs for maintenance and operation of the project allocated to water supply for immediate use after the project is first used for storage of water for water supply purposes (presently estimated at \$5,900 annually or 25.7 percent of the total

annual project cost for maintenance and operation); and, in addition, that portion of the costs for maintenance and operation of the project allocated to future water supply when such water supply is first used (presently estimated at \$9,100 annually or 39.5 percent of the total annual project costs for maintenance and operation); and

(d). Payment to the United States, when incurred, of the portion of the costs allocated to water supply for major replacements.

Water rights necessary for the use of the stored water for water supply purposes shall be obtained as necessary by the water user who will also be required to hold the Government harmless from liability for or on account of any claim for damages which may be made or asserted as the result of the storage and withdrawal of water by the user. Use of the water shall be in a manner consistent with Federal and State laws.

Local interests shall also give assurances satisfactory to the Secretary of the Army that they will establish encroachment lines downstream of the recommended project to permit reasonable, efficient reservoir operation.

On the basis of the Administration's position, as set forth in H. R. 5269, 89th Congress, First Session, prior to initiation of construction of the Trumbull Pond Dam and Reservoir, local interests would also be required to furnish assurances satisfactory to the Secretary of the Army that, in accordance with the proposed Federal Water Project Recreation Act cited above, they will:

a. Administer project land and water areas for recreation and fish and wildlife enhancement;

b. Pay, contribute in kind, or repay (which may be through user fees) with interest, one-half of the separable cost of the project allocated to recreation and fish and wildlife enhancement, an amount currently estimated at \$25,000 based on the presently planned level of development for these purposes; and

c. Bear all costs of operation, maintenance and replacement of lands and facilities for recreation and fish and wildlife enhancement, an amount currently estimated at \$4,700 on an average annual basis.

Provided, that the sizing and responsibility for development, operation, maintenance, and replacement of the recreation and fish and wildlife enhancement features of the reservoir may be modified in accordance with the alternatives provided in the proposed Federal Water Project Recreation Act cited above, depending upon the intentions of non-Federal interests regarding participation in the costs of these features at the time of reservoir construction and subsequent thereto, and that appropriate adjustments reflecting such modifications may be made in the allocation of costs to other project purposes.

The net first cost to the United States for the Trumbull Pond Dam and Reservoir, under the provisions of the Water Supply Act of 1958, as amended, and H. R. 5269, would be \$2,500,000, after payment by local interests of costs allocated to water supply and recreation and fish and wildlife enhancement, based on the presently planned level of development for these purposes. Net average annual costs to the United States for operation, maintenance, and major replacements are estimated at \$5,200.

R. R. PLOGER
Colonel, Corps of Engineers
Division Engineer

2 Incl

1. Appendices A through I
2. Attachment 1

ACKNOWLEDGEMENTS AND IDENTIFICATION OF PERSONNEL

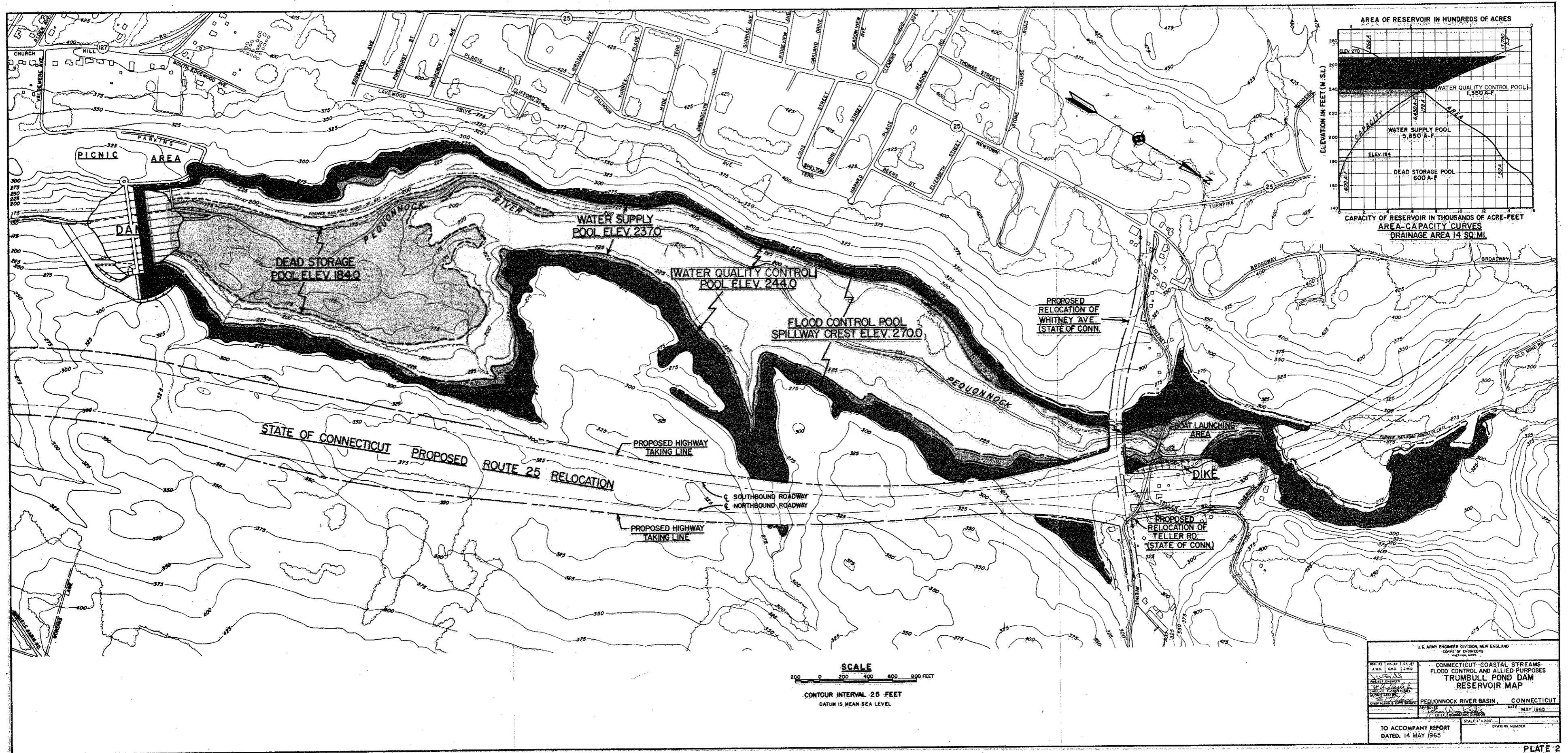
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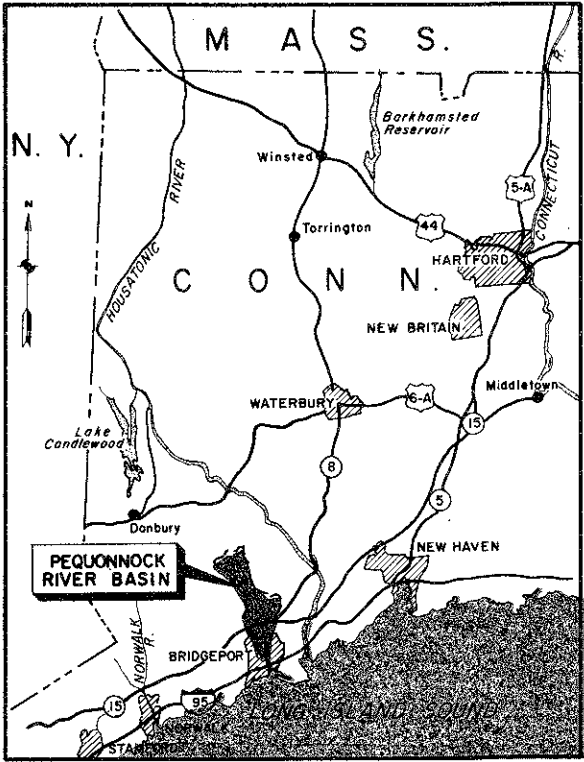
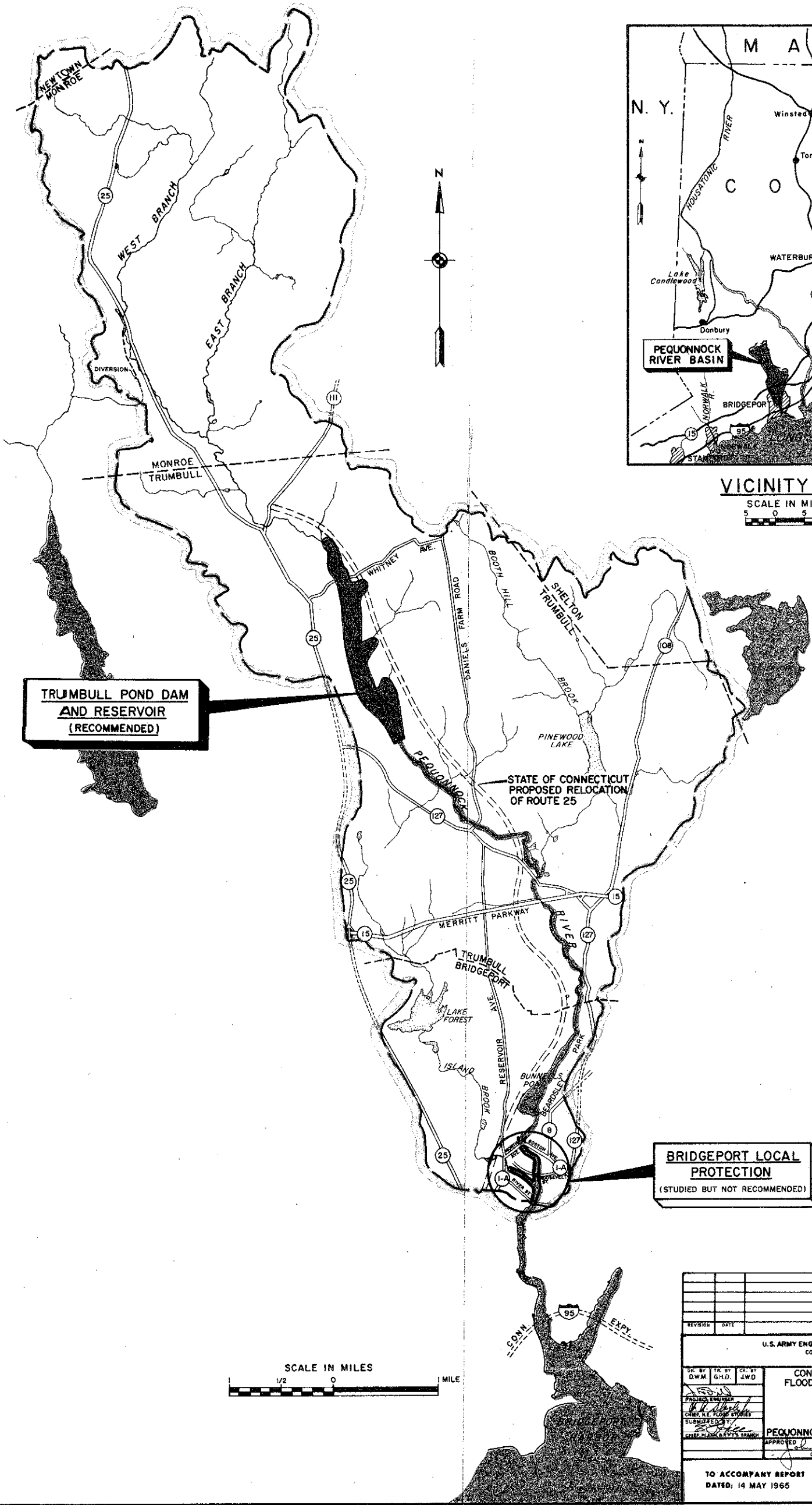
Colonel Robert R. Ploger, Division Engineer
John Wm. Leslie, Chief, Engineering Division
Edward L. Hill, Chief, Planning and Reports Branch
William A. Slagle, Jr., Chief, Northeast Flood Studies

2. This report was prepared under the direction of J. W. Dill, Project Engineer.

3. The U. S. Army Engineer Division, New England, is appreciative of the cooperation rendered in connection with this study by personnel of other Federal agencies, State agencies, and local interests, particularly the following:

U. S. Fish and Wildlife Service
U. S. Public Health Service
Connecticut Water Resources Commission
Connecticut State Highway Department
Bridgeport Hydraulic Company



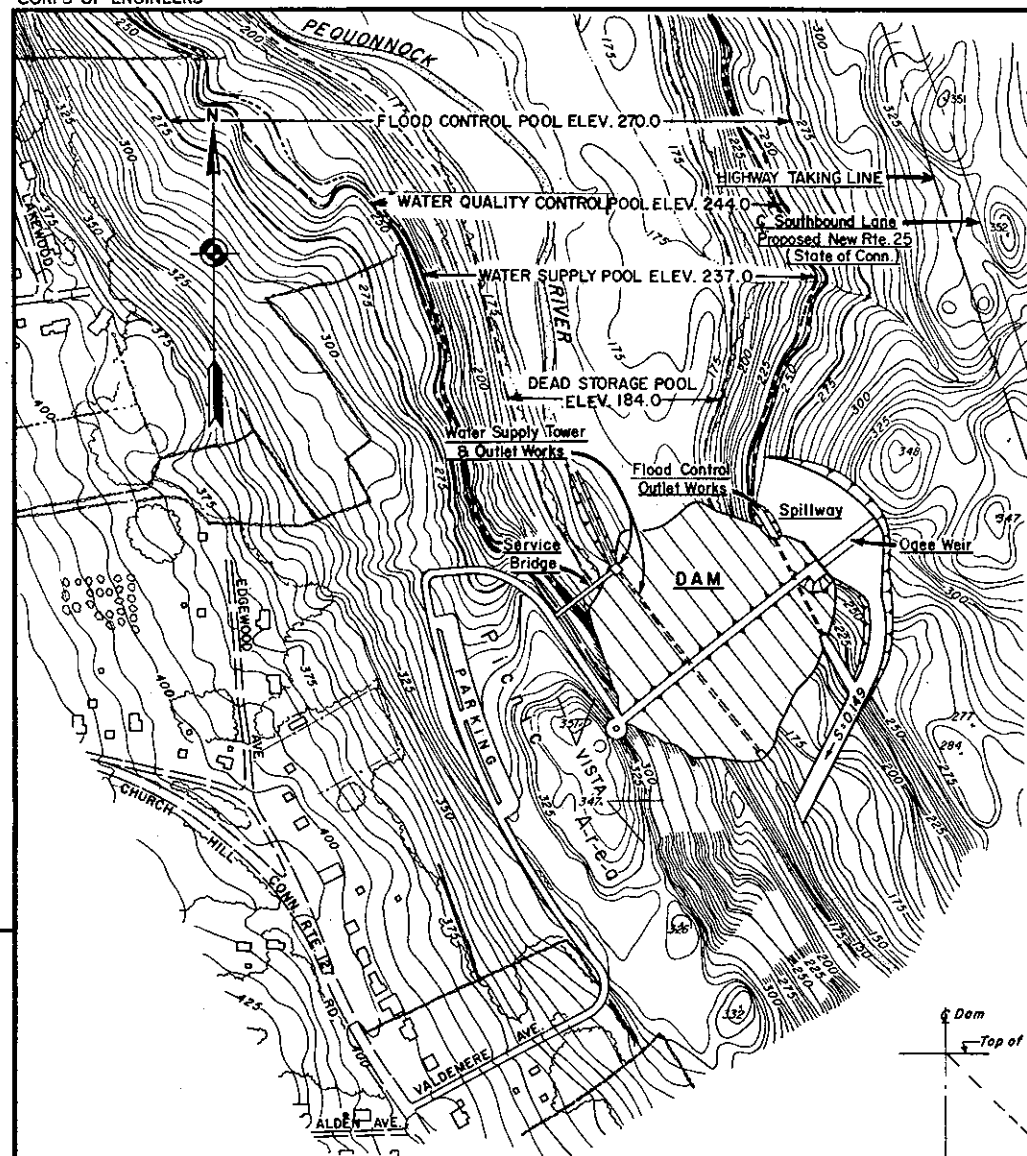


VICINITY MAP

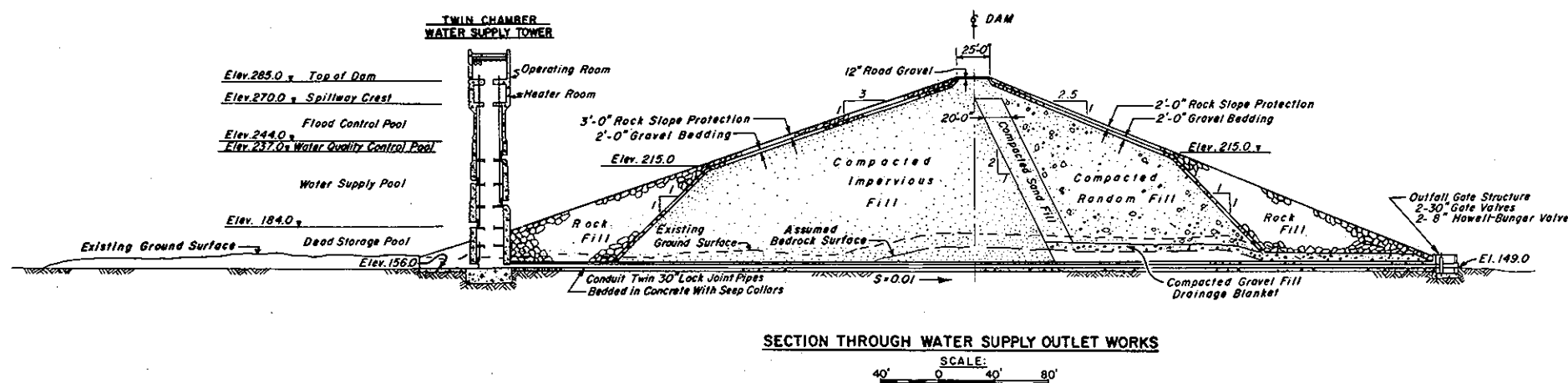
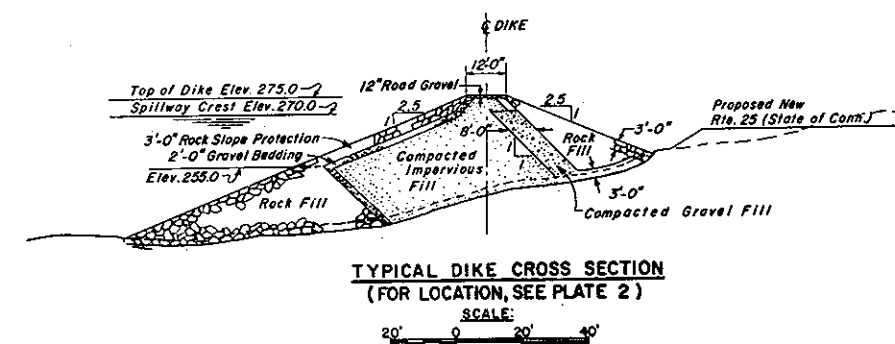
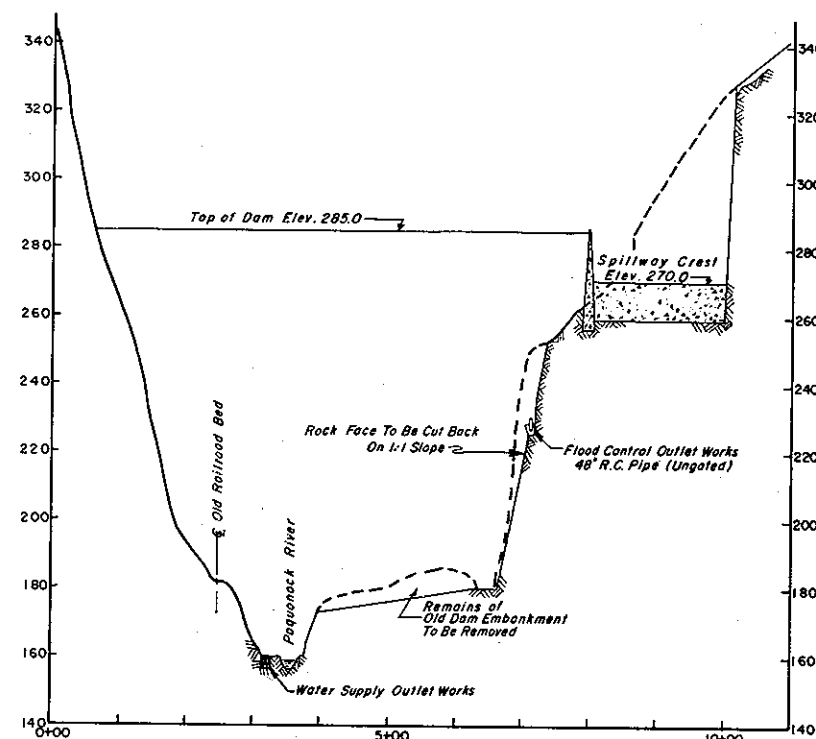
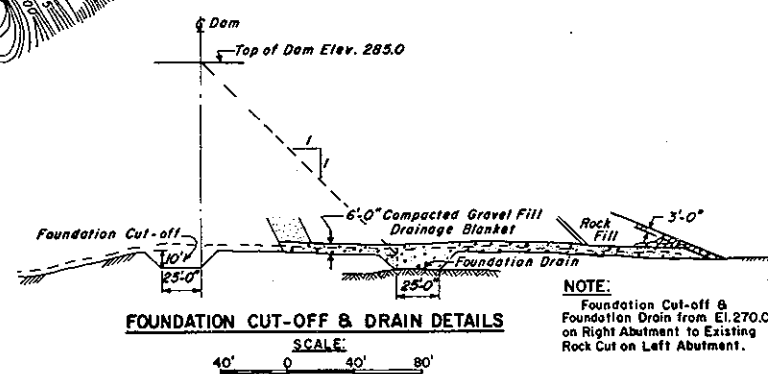
TRUMBULL POND DAM
AND RESERVOIR
(RECOMMENDED)

BRIDGEPORT LOCAL
PROTECTION
(STUDIED BUT NOT RECOMMENDED)

REVISION	DATE	DESCRIPTION	BY
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.			
CONNECTICUT COASTAL STREAMS FLOOD CONTROL AND ALLIED PURPOSES PEQUONNOK RIVER BASIN MAP			
APPROVED		DATE MAY 1965	
SUBMITTED BY		CHIEF ENGINEERING DIV.	
TO ACCOMPANY REPORT DATED: 14 MAY 1965		DRAWING NUMBER	



**DAM
GENERAL PLAN**
SCALE:
200' 0 200' 400'



REVISION		DATE	DESCRIPTION	BY
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.				
CONNECTICUT COASTAL STREAMS FLOOD CONTROL AND ALLIED PURPOSES TRUMBULL POND DAM GENERAL PLAN				
PROJECT ENGINEER		PEQUOT RIVER BASIN, CONNECTICUT		
CHECKED BY		DATE MAY 1965		
APPROVED BY		CHIEF, ENGINEERING DIVISION		
TO ACCOMPANY REPORT DATED: 14 MAY 1965		DRAWING NUMBER		

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- B Hydrology and Hydraulics
- C Flood Losses and Benefits
- D Recommended Project
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- G Fish and Wildlife Report
- H Other Projects Studied
- I Letters of Comment and Concurrence

ATTACHMENT 1 - Information Called for By S-148

APPENDIX A
DIGEST OF PUBLIC HEARING

APPENDIX A

DIGEST OF PUBLIC HEARING

A public hearing was held in Trumbull, Connecticut, on 8 December 1964, to explain the details of the considered multiple-purpose dam and reservoir on the Pequonnock River at Trumbull for flood control, water supply, low flow augmentation, and recreation and to ascertain the views of local interests on this project and any other proposals for flood control and allied purposes in the Pequonnock River basin. Approximately 125 people attended the hearing, including representatives of Federal, State, and local governments; the water supply company in the area; and industrial, commercial, and civic groups and interested individuals. Digests of the public hearing and letters relative to the hearing are made a part of this Appendix. Colonel Edward J. Ribbs, Deputy Division Engineer, was the hearing officer.

DIGEST OF PUBLIC HEARING - 8 December 1964
TRUMBULL, CONNECTICUT

Speaker	Interest Represented	Improvement Desired and/or Comments
Mr. Joseph P. Donahue	The Hon. John S. Monagan, U.S. House of Representatives	Wishes to listen and report to Representative Monagan.
Mr. John J. Curry, Chief Engineer, Water Resources Commission	The Hon. John Dempsey, Governor of Connecticut	State of Conn. will wait for later stage of planning and consider benefits before expressing itself on the project.
Mr. Joseph W. Voboril, Jr.	Dept. of Agriculture and Natural Resources, State of Connecticut	Reads letter (made Exhibit No. 1) from Joseph N. Gill, Commissioner, stating that out-of-bank flows from minor storms threaten recent and expected developments. Land treatment measures and multiple-purpose structures are needed. All information gathered by Corps of Engineers should be made available to public agencies.
Mr. Robert A. Norton	Conn. State Highway Dept.	Reads letter from Howard S. Ives, State Highway Commissioner, stating that modification of profile for Route 25 will be required if multiple-purpose dam is approved, as described, and that the Department will cooperate in developing plans. Mr. Norton states that construction of this highway is some 5 to 10 years away.
Mr. Cole W. Wilde, Chief, Fisheries Division	Connecticut Board of Fisheries and Game	Board concurs with report of U.S. Fish & Wildlife Service on Trumbull Pond project; commends Corps of Engineers for plans to provide for trout fishery.

Speaker	Interest Represented	Improvement Desired and/or Comments
Mr. Clarence F. Heimann First Selectman	Town of Trumbull	Board of Selectmen favor Trumbull Pond Dam in principle. Speaker described October 1955 flooding of Daniels Farm Road; says Twin Brooks Park and Trumbull flood plain development require flood protection; project recreation facilities are needed, particularly to provide a nearby swimming site and low flow augmentation for downstream fishing. He suggests road along top of dam be considered to meet need for cross-town access.
Mr. Alton C. Elterich	Board of Finance, Town of Trumbull	Desires to know cost of project to town, specifically cost for raising Whitney Ave. and for bridge. (Ed note: Hearing officer explains that these are Federal cost items.)
Mr. Fred B. Silliman, President	Bridgeport Hydraulic Co.	States that Trumbull basin is needed to meet future water supply requirements of the area. Reads letter (made Exhibit No. 2) from the Bridgeport Hydraulic Company expressing interest in water supply features of the project. In response to question from the floor, speaker says that Trumbull Pond Dam would have been built ten years previously but it was decided to develop Housatonic well field first.

Speaker	Interest Represented	Improvement Desired and/or Comments
Mr. Lester A. Nothnagle, Sr., Chairman	Planning & Zoning Commission, Town of Trumbull	Thinks that project would provide much needed security for Twin Brooks area and give general recreational advantages. Says he echoes Mr. Heimann's request for consideration of road across dam. (See page A-3 of this Appendix.)
Mr. Hyung C. Chung, Planning Director	Greater Bridgeport Regional Planning Agency	The Agency believes that project proposed by Corps of Engineers is in accord with Agency's basic policy of regional development and should be carried out as early as possible. All phases of study should be made known to this and other agencies. (Statement marked Exhibit No. 3.)
A-3 Mr. E. Merrill Beach, Vice-President	Trumbull Park Commission	Project is last chance for town to get recreational facilities of this nature, he states. At end of last swimming season water was very low, endangering purity of fishery, and Twin Brooks swimming area.
Mrs. Paula A. Elterich	Conservation Commission	The Commission supports program for multiple-recreational purposes and expansion of highways. Believes that the project, possibly with a road across top of dam, would facilitate use of water and recreational facilities.

Speaker	Interest Represented	Improvement Desired and/or Comments
Mr. Nils B. Bengston	Trumbull Conservation Commission	Speaker would like open space preserved along the taking line of Route 25 and up to 400 feet from top of water along the reservoir.. (Ed note: Hearing officer points out that Corps of Engineers policy is to obtain a strip extending 300 feet beyond flood line of all Federal reservoirs and to purchase property under the provisions of severance.)
Mr. Charles O. Kishibay Past Chairman, Flood Control Board	Resident of Trumbull	Stating that the important part of the proposed project is flood control, he describes flood conditions in 1955.
Mr. Alexander Read, Conservation Counselor	Boy Scouts of America and Fairfield County Fish & Game Protective Association	People in the groups he represents favor this project very much.
Mrs. Frank Mylen	Resident of Trumbull	Asks whether her property, on Riverside Avenue, will be taken for this project or for Route 25 construction.
Mrs. L. W. Navetski Water Resources Chairman	Bridgeport Area - League of Women Voters	Asks if there will be a conflict of interest between use of reservoir for flood storage and for other storage uses. (Ed note: Hearing officer states that reservoir with full water supply and low flow pool would also provide storage for recurrence of October 1955 flood.)

Speaker	Interest Represented	Improvement Desired and/or Comments
Mr. Frank E. Albright	Resident of Trumbull	Asks why it is necessary to build so high a dam. Asserts that recreation and access will be denied. (Ed note: Hearing officer, and Mr. Silliman of Bridgeport Hydraulic Company explain that limited water-based recreation and access are assured.)
Mrs. Andrew Pato	Resident of Trumbull	Asks if motor boating and swimming would be permitted, and if water company will profit at public expense. (Ed note: Mr. Silliman suggests reference to the regulations of State Board of Health; Hearing officer explains that the Utility Commission would insure water rates fair to the public and to the water company.)
Mr. Kingston C. Smith Plant Engineer	Sikorsky Aircraft Div., United Aircraft Corp.	Sees no need for raising reservoir so high that it inundates leaching field of St. Joseph's Manor or goes into area of Whitney Avenue.
Mr. Lawrence W. Behn	Resident of Trumbull	Believes there is need for the proposed project. Cites Mansfield Hollow Dam and Reservoir as an example of an effective Federal project.
Mr. Frank A. Haux	Fairfield County League of Sportsmen's Clubs	Favors the multiple-purpose project in view of the recreational need of the area.

Speaker	Interest Represented	Improvements Desired, and/or Comments
Mr. Bertram L. Bernstein	Fairfield County League of Sportsmen's Clubs and Lake Hills Association, in Fairfield	Town should figure on expense of a sewage disposal plant if they expect water from the reservoir, he states.
Mr. George Delimon	Resident of Trumbull	Wants to know how soon project will be used as a reservoir for water supply.
Mr. Leonard K. Morse	Resident of Trumbull	Asks how much town of Trumbull would be losing in tax revenue on land taken for reservoir area.
Mr. Charles W. Hawley	Resident of Trumbull	Asks if hydro-electric power will be included. Asserts that the proposed project will spoil the gorge, reduce recreational use of the area, and aggravate pollution. Zoning should have been effected in previous years as a flood solution. Asks if zoning can be established now to diminish size of dam? Asks if project could have handled floods of 1955 in reverse order. (Ed note: Hearing officer explains that project does not include hydro-power, the gorge, lying downstream of the dam will be preserved; pollution is practically non-existent; recreation will not only be maintained but augmented by assurance of cold water flows in summertime. Project would have stored both floods of 1955 in either order of occurrence.)

<u>Speaker</u>	<u>Interest Represented</u>	<u>Improvements Desired, and/or Comments</u>
Mrs. Moulton Property Owner		Wants to know if Government would buy all the land around reservoir. (Ed note: Hearing officer explains would buy only to 300 feet beyond high water line plus severance.)
Mr. Al Shiro	Resident of Trumbull	Asks information about type of construction and design data to be used for the proposed project.

LETTER RECEIVED BUT NOT READ AT THE HEARING

<u>Writer</u>	<u>Interest Represented</u>	<u>Digest of Letter</u>
Mr. Robert W. Kascak	Resident of Trumbull	Prefers to call flooding in the Pequonnock basin a runoff condition since it is caused by heavy rain, not necessarily by hurricane or flood. The build-up in the towns in the basin results in filling of swamps and ponds; therefore, towns are partly responsible and will save great cost of channel work if they accept Federal assistance through this project. Writer includes photographs of high water marks.

APPENDIX B

HYDROLOGY AND HYDRAULICS

APPENDIX B
HYDROLOGY AND HYDRAULICS

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APPENDIX B

HYDROLOGY AND HYDRAULICS

1. INTRODUCTION

This appendix presents climatological and hydrological data for the Pequonnock River basin, and includes analyses of floods of record, development of synthetic floods, and analyses of various flood control measures.

GENERAL DESCRIPTION

2. PEQUONNOCK RIVER BASIN

The Pequonnock River basin, shown on Plate B-1, is located in the coastal region of southwestern Connecticut. The long and narrow basin is oriented generally in a north-south direction and drains an area of 28.3 square miles. The overall length and maximum width of the basin are about 10 and 3 miles, respectively. The topography of the basin is hilly and, except for the urban areas of Bridgeport and Trumbull, is covered by a mixture of hard and soft woods.

3. PEQUONNOCK RIVER

The Pequonnock River is formed by the East and West Branches which join in the town of Monroe. From this confluence the river flows in a southerly direction for about 12 miles to its mouth in Bridgeport Harbor on Long Island Sound. Below the confluence of the East and West Branches, the Pequonnock River is essentially a single branch stream having only two major tributaries, Booth Hill Brook, which joins the main stem in Trumbull, and Island Brook, a downstream tributary which enters the river in the tidal reach within the city of Bridgeport. The main stem falls about 300 feet over its 9.6 mile length to tide water. The stream profile, shown on Plate B-2, is a series of relatively flat reaches connected by steep rocky rapids and falls. Some of the steeper falls have been utilized over the years for water power. Bunnells Pond dam, the only remaining development on the main river, is located in Bridgeport just above tidewater and is currently used for recreational purposes.

4. TRIBUTARIES

a. West Branch. The West Branch, Pequonnock River originates in Pine Swamp north of the Trumbull-Monroe town line and drains an area of about 4.6 square miles. The stream bed falls about 160 feet over its 5 mile length. Upper Stepney diversion, located about 1.2 miles above the confluence with the East Branch, is operated and maintained by the Bridgeport Hydraulic Company. The diversion works direct some of the runoff from about 3.9 square miles of the West Branch drainage area into the Mill River and thence into Easton Reservoir for water supply purposes.

b. East Branch. The East Branch, Pequonnock River drains an area of about 3.7 square miles. The stream bed falls about 150 feet in its 4.5 mile length. The central portion of the watershed has a flat gradient and contains a relatively large amount of valley storage.

c. Booth Hill Brook. Booth Hill Brook joins the Pequonnock River at mile 3.5 and has a drainage area of 5.5 square miles. Most of the watershed is above Pinewood Lake, located about 1.2 miles above the mouth of Booth Hill Brook. The lake has a surface area of about 60 acres and is privately owned and primarily used for recreational purposes. The level of the lake is maintained by a gated outlet and an uncontrolled spillway located in a saddle west of the lake. Below the lake, the stream bed falls a total of 90 feet in 1.2 miles; however, 70 feet of this fall is in the half-mile reach immediately below the lake outlet.

d. Island Brook. Island Brook flows into the Pequonnock River at tidewater within the city of Bridgeport. The brook drains an area of 3.1 square miles most of which is located in the highly developed residential sections of Trumbull and Bridgeport. Of the total drainage area, 1.5 square miles are above Lake Forest, located 2.5 miles above the mouth of Island Brook. The lake has a surface area of about 65 acres and is privately owned. The level of the lake is controlled by a gated outlet and an uncontrolled spillway in the dam. The stream bed below Lake Forest is relatively steep, falling about 150 feet in 2.5 miles.

HYDROLOGY

5. CLIMATOLOGY

The Pequonnock River basin has a variable climate and, due to its proximity to the Atlantic Ocean, escapes the severity of cold and depth of snowfall experienced in the higher elevations of the interior areas of New England. It frequently experiences periods of heavy precipitation produced by local thunderstorms and larger weather systems of tropical and extra-tropical origin. The basin lies in the path of the prevailing "westerlies" which generally travel across the country in an easterly or northeasterly direction producing frequent weather changes.

a. Temperature. The average annual temperature of the Pequonnock River basin is about 51°F. Extremes in temperature range from occasional highs of 100°F. to lows of -20°F. Freezing temperatures may be expected from the latter part of October until the middle of April. The mean, maximum, and minimum monthly and annual temperatures for the period of record at Bridgeport are shown in Table B-1.

b. Precipitation. The mean annual precipitation over the Pequonnock River basin is about 48 inches. The distribution of the precipitation is approximately uniform throughout the year. However, extremes in monthly values range from a high of more than 18 inches recorded in July 1897 to less than 0.20 inches on several occasions. The monthly and annual precipitation at Bridgeport, Trap Falls and Easton Reservoirs for the periods of record are shown in Table B-2.

c. Snowfall. The average annual snowfall over the Pequonnock River basin (Table B-3) is about 35 inches. Significant depth of snow covers the basin sporadically from December through mid-March. The water content of the snow cover, however, seldom exceeds 1 inch and solid cover lasts only for short periods due to the moderating effect of Long Island Sound.

TABLE B-1

MONTHLY TEMPERATURES

(Degrees Fahrenheit)

Bridgeport, Connecticut

Elevation 7 feet msl

66 Years of Record

<u>Month</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
January	29.5	68	-14
February	29.9	70	-20
March	37.8	85	1
April	48.1	97	9
May	57.0	95	26
June	67.5	99	34
July	73.1	103	44
August	71.3	101	38
September	65.2	98	32
October	54.5	90	20
November	43.5	80	8
December	32.3	67	-12
ANNUAL	51.0	103	-20

TABLE B-2

MONTHLY PRECIPITATION RECORD
(in inches)

	Bridgeport, Connecticut Elevation 7 feet msl 68 Years of Record			Trap Falls Reservoir, Conn. Elevation 320 feet msl 23 Years of Record			Easton Lake Reservoir, Conn. Elevation 260 feet msl 23 Years of Record		
<u>Month</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
January	3.76	7.88	.51	3.80	7.85	.70	3.31	7.36	.53
February	3.47	6.32	.85	3.32	5.57	1.87	3.07	4.75	1.73
March	4.18	9.64	.29	5.00	14.47	1.73	4.73	12.73	1.92
April	3.90	9.41	.69	4.35	8.66	1.15	4.15	7.23	.75
May	3.78	10.18	.49	4.21	7.94	.79	4.28	8.55	.92
June	3.29	8.48	.06	3.20	6.26	.28	3.21	5.29	.15
July	4.05	18.77	.45	4.53	9.42	.51	4.31	7.45	.41
August	4.45	13.29	.20	4.50	13.41	.96	4.15	12.61	1.42
September	3.73	14.15	.09	3.89	11.39	.14	3.72	10.71	.03
October	3.64	10.72	.30	4.10	17.24	.28	3.65	15.17	.25
November	3.78	7.60	.81	5.02	7.99	1.48	4.84	7.52	1.54
December	3.83	9.85	.33	4.04	7.84	.74	3.87	6.71	.54
ANNUAL	45.86	64.23	29.57	49.96	63.92	38.74	47.29	61.79	38.13

TABLE B-3

MEAN MONTHLY SNOWFALL
AVERAGE DEPTH IN INCHES

Bridgeport, Connecticut
Elevation 7 feet msl
62 Years of Record

<u>Month</u>	<u>Snowfall</u>
January	8.7
February	10.1
March	6.9
April	1.3
May	0.0
June	0.0
July	0.0
August	0.0
September	0.0
October	0.0
November	1.5
December	6.5
ANNUAL	35.0

d. Storms.

(1) General. The Pequonnock River basin has experienced four general types of storms:

(a) Extra-tropical continental storms which move across the basin under the influence of the prevailing westerlies.

(b) Extra-tropical maritime storms which originate and move northward along the eastern United States coast.

(c) Storms of tropical origin, some of which attain hurricane magnitude.

(d) Thunderstorms produced by local convective activity or more general frontal activity.

(2) July 1897 storm. Records for Bridgeport show that a major rainstorm occurred over the Bridgeport area in July 1897. This storm, which centered over Southington, about 30 miles northeast of Bridgeport, produced about 8 inches of rainfall over the maximum 24-hour period and 10.3 inches for the total storm which lasted from about 10 P.M. 12 July to 12 Noon 14 July.

(3) July 1905 storm. The storm of July 1905 was of the thunderstorm type and local in character centering over the Bridgeport area. Rainfall totaling 8 to 11 inches fell in about 17 hours over the Pequonnock River basin. The total storm deposited 11.32 inches of rainfall in Bridgeport from about 11:30 A.M. 29 July to 5:30 A.M. 30 July, which is the heaviest downpour ever recorded in Bridgeport.

(4) March 1936 storms. A succession of four continental disturbances of the cold frontal-type accompanied by heavy rains over the entire northeastern part of the United States occurred during the period of 9-22 March with the heaviest rainfall occurring in the periods of 9-13 and 16-22 March. Rainfall during the two periods was about equal over the Pequonnock River basin totaling about 6 inches for the entire period. No abnormal tides were experienced during this period.

(5) September 1938 storm. A stationary cold front along the Atlantic coast was overrun by a rapidly moving tropical hurricane producing record-breaking rainfall over large areas of Connecticut, Massachusetts and New Hampshire. The storm started with light rain which gradually increased in intensity over a 4-day period, becoming a heavy downpour. This rainfall pattern was especially conducive to high peak discharges due to the filling of ponds, lakes, and swamps and saturation of the soil surface before the period of intense rainfall occurred. Moreover, rainfall during the previous month had been heavier than normal. The total storm rainfall deposited about 11.2 inches in Bridgeport for the period 17-21 September. The hurricane produced abnormally high tides in Long Island Sound and the tidal estuaries along the Connecticut coast.

(6) December 1948 - January 1949 storm. The "New Year's" storm of 1949 was typical of winter cyclonic storms of continental origin. It was characterized by a low pressure area which deepened and intensified as it moved northward from the middle Atlantic coast.

Upon approaching the New England area, the northward movement of the low pressure area became blocked by an area of high pressure over the North Atlantic Ocean, and the circulating warm, moist air became mixed with the cold air resulting in intense rainfall over eastern New York State and western New England. The rainfall over the Pequonnock River basin averaged about 5.1 inches for the period 29 December 1948 to 1 January 1949. The storm did not produce abnormal tides along the Connecticut coast.

(7) August 1955 storm. The storm which accompanied hurricane Diane in August 1955 produced record floods in many streams of southern New England. The accompanying rains fell on ground previously saturated by rainfall from hurricane Connie, which occurred one week earlier. Rainfall amounts for the period of the 17th - 20th averaged 6.0 inches over the Pequonnock River basin. Tides along the Connecticut coast were not abnormally high as the hurricane passed along the south coast of Long Island.

(8) October 1955 storm. The storm of 14-17 October originated as an extra-tropical low pressure area off the Florida coast. The northward moving low pressure system became stalled off the New Jersey coast when a strong high pressure area located in the vicinity of Labrador and the Gulf of St. Lawrence blocked its course. The warm, moist tropical air circulating about the low pressure area overran the cooler air mass of the high pressure system and intense rainfall resulted over much of southern New England. This storm produced record floods in the Connecticut coastal streams. Rainfall over the Pequonnock River basin averaged about 9.1 inches for the period 14 to 17 October. In addition to the fresh water flooding, tides in Long Island Sound reached a maximum of about 4 feet above the predicted normal. These abnormal tides occurred over a period of about 72 hours.

6. RUNOFF

a. Discharge records. There are no published records of stream flow in the Pequonnock River. However, since November 1961, the U.S. Geological Survey has operated a crest gage and made numerous current-meter measurements at Trumbull. Pertinent data for adjacent watersheds, including the Pomperaug River at Southbury, Still River near Lanesville, Copper Mill Brook near Monroe, and Saugatuck River near Westport, are shown in Table B-4.

TABLE B-4

GAGING STATION RECORDS
ADJACENT WATERSHEDS
THRU WATER YEAR 1962

<u>Watershed and Gaging Station</u>	<u>Drainage Area (sq. mi.)</u>	<u>Period of Record</u>	<u>Discharge (CFS)</u>		
			<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
Pomperaug River at Southbury, Conn.	75.3	1932-present	128	29,400 8/19/55	3.3 8/27/49
Still River near Lanesville, Conn.	68.5	1931-present	122	7,980 10/16/55	5.0 10/20/46
Copper Mill Brook near Monroe, Conn.	2.5	1958-present	-	330 3/12/62	0.1 9/22/62
Saugatuck River near Westport, Conn.	59.6	1932-present	-	14,800 10/16/55	0.2 10/19/53

b. Low flow analysis. Hydrologic studies of adjacent gaged watersheds were made in order to determine the dependability and yield of flow in the Pequonnock River. From the analyses, it was concluded that the Pomperaug River watershed has the most nearly similar runoff characteristics to the Pequonnock River of those for which discharge records were available. Natural flow-duration curves from data developed by the U. S. Geological Survey for the Pomperaug River at Southbury and the Still River at Lanesville are shown on Plate B-3.

The storage required to supplement the natural low flow at the Trumbull damsite was determined for various rates of yield using the lowest mean discharge for selected numbers of consecutive days in each year of the 28-year record of the Pomperaug River. The average annual flow is estimated to be 1.8 csm based on records from other streams in southern Connecticut. Curves of yield versus storage requirement with frequency as a parameter were drawn through points determined from storage values arranged in order of magnitude and assigned frequency plot positions based on the following equation:

$$1 - P_1 = (0.5)^{1/N}$$

where P_1 is the plotting position in events per hundred years for the largest event, and N is the number of years of record. The plotting position for the smallest event is the complement of this value, and all other plotting positions are interpolated linearly between the two. Curves of yield versus storage, shown on Plate B-4, indicate that the desired yield of 14 cfs (9 MGD), with 98 percent dependability, would require storage of 4,400 acre-feet. In accordance with the requirements of the Bridgeport Hydraulic Company (the probable water user), a 2-month emergency reserve was added to assure the safe yield of 9 MGD which is based on computations from a short period of record on a nearby stream and to provide insurance should other sources of supply fail. This increased the water supply storage to 5,850 acre-feet. The curves also indicate that adding 1,350 acre-feet of storage would yield the 3.0 c.f.s. desired for stream regulation by the Fish and Wildlife Service (see Appendix G).

7. TIDE DATA

The normal tide range in Bridgeport Harbor between mean low water (elevation 3.2 feet below mean sea level), and mean high water (elevation 3.6 feet above mean sea level), is 6.8 feet. Mean high and maximum high spring tide levels are about 4.2 and 5.4 feet msl, respectively. The maximum experienced tide is 9.2 feet msl which has occurred twice during the past 25 years and was produced by hurricanes in September 1938 and September 1954. A tide-frequency curve for Bridgeport Harbor, based on 147 years of combined tide gage records, high water marks, and historical accounts, is shown on Plate B-5.

8. FLOOD HISTORY

a. General. The history of floods in the Pequonnock River basin indicates that floods may be experienced in all seasons of the year. The principal cause of floods has been heavy rainfall alone. However, below Bunnells Pond dam in Bridgeport, occasional abnormally high tides have coincided with heavy rainfall. As far as can be determined, there have been no reports of serious flooding in the project area attributable to tides alone.

Since the turn of the century, records and newspaper accounts indicate that several damaging floods have occurred, particularly noteworthy are the July 1905 and October 1955 floods. Because of the limited information available concerning the 1905 flood, it is difficult

to determine which of these floods was of greater magnitude. The October 1955 flood is considered to be a major flood on the Pequonnock River and was therefore used as a criterion in evaluating the basin characteristics. In addition to the 1955 flood, 11 other floods of various magnitudes have occurred on the Pequonnock River since 1935. These floods, although lesser in magnitude, caused frequent disruption of traffic and minor damages.

b. Major floods.

(1) 29-30 July 1905. Death and destruction were caused by the so-called "Bridgeport flood" of 1905 which lasted from noon 29 July to noon 30 July. The storm, with a recorded rainfall total of 11.32 inches in Bridgeport, produced a flood which overtaxed the Pequonnock River channel, resulting in much debris and the progressive failure of four dams and the Boston Avenue bridge, each one adding to the magnitude of the floodwave and its accompanying debris. The dam failures included the following:

(a) Toucey Dam on a brook entering the Pequonnock River gave way about midnight 29 July. The dam was 100 feet long, 10 feet high and built of rubble-cement masonry.

(b) Wards Mill Dam at Trumbull failed by sliding when the flood wave from Toucey Dam struck it. The dam was 60 feet long, 15 feet high and built of rubble-cement masonry founded on ledge rock.

(c) About 1 A.M. 30 July, Bunnells Pond dam failed from overtopping due in part to debris blocking the spillway. The structure was 800 feet long, 28 feet high and built of earth with a masonry spillway.

(d) The Berkshire Mill dam located at tidewater was 140 feet long and 7 feet high and probably failed from undermining.

In addition to the loss of the bridges and dams, two lives were lost and extensive damage was incurred to residential and commercial properties.

(2) 14-17 October 1955. Of the more recent floods, the October 1955 flood was by far the most destructive. During this storm, which extended over a 72-hour period from 14-17 October, 9.02 inches of rainfall was recorded at Easton Reservoir, 11.16 inches at Hemlock

Reservoir, and 7.15 inches at Bridgeport. The rainfall at the above mentioned reservoirs is considered indicative of the rainfall over the upper Pequonnock River basin. The flood caused by this rainfall was intensified by a previous storm on 6-8 October, which satisfied the initial soil deficiencies, and by abnormally high tides which reached 8.0 feet msl in Bridgeport Harbor.

The peak discharge of the October 1955 flood at Trumbull, as estimated by the U. S. Geological Survey, was 4,110 cfs (285 csm) for 14.4 square miles of the Pequonnock River basin. From available high water marks and rating curves developed for the Pequonnock River in Bridgeport, it is estimated that the October 1955 flood reached a maximum discharge of about 5,800 cfs (230 csm) at the Boston Avenue bridge (DA 25.2 square miles). A hydrograph of the October 1955 flood and mass rainfall curves are shown on Plate B-6.

The flood washed away roadways in Trumbull and Beardsley Park in Bridgeport, and inundated the Boston Avenue and Island Brook Avenue areas in depths up to about 6 feet of water. Residences along the Pequonnock River from Trumbull to Bridgeport were also damaged from the October flood. In a recurrence of the October 1955 flood, damages would be much greater than experienced due to the increased commercial development on the left bank of the Pequonnock River in the Bridgeport area.

The October 1955 flood profile on the Pequonnock River was developed from recent field investigations and interviews with local inhabitants. The profile is shown on Plate B-2.

c. Flood frequencies. Flood frequency curves, shown on Plate B-7, were developed for selected locations in the Pequonnock River basin based on a regional analysis in accordance with procedures described in ER 1110-2-1450, "Hydrologic Frequency Estimates," dated 10 October 1962. A skew coefficient of 1.0 was adopted for the Pequonnock River basin frequency analysis.

9. ANALYSIS OF FLOODS

Past floods were analyzed in detail in order to determine the hydrologic characteristics of floods in the Pequonnock River. These studies provided a basis for economic evaluation and derivation of project design floods for the flood control project. General conclusions resulting from the analysis of the floods are as follows:

a. The Pequonnock River is a rather flashy coastal stream. Flood peaks usually occur within 2 hours after the cessation of rainfall.

b. There is insufficient natural valley storage or surcharge storage in the basin to effectively desynchronize tributary peaks with flows traversing the main stem.

c. Except for minor diversion of flow near Upper Stepney, the entire watershed may contribute to flooding of the damage areas concentrated in the lower basin.

d. The lower reaches of the Pequonnock River and Island Brook are tidal estuaries. Properties adjacent thereto are susceptible to flooding from a combination of stream flows and abnormal tides.

e. Floods may result from rainfall alone or in combination with abnormal tide, but abnormal tide alone will not produce significant damage.

f. Since the flood of October 1955, extensive commercial development has taken place in Bridgeport, and in this reach the river has been put into a concrete conduit which has an estimated capacity of 5,800 cfs.

10. STANDARD PROJECT FLOOD

a. Standard project storm. A standard project flood was developed for the Pequonnock River at Bridgeport. Flood hydrographs were derived from adopted unit hydrographs and standard project storm rainfall, as described in Civil Engineer Bulletin No. 52-8.

The standard project storm was oriented over the Pequonnock River basin to produce the most critical conditions in Bridgeport. The average basin rainfall was determined for a drainage area of 50 square miles. Losses from infiltration, surface detention, and transpiration were assumed at a rate of 0.1 inch per hour. A summary of the adopted standard project storm is as follows:

Standard Project Storm Rainfall (24 hrs.)	11.60 inches
Losses	1.96
Rainfall Excess (24 hrs.)	9.64 inches
Maximum 2-Hour Rainfall Excess	5.96 inches

b. Pequonnock River SPF. A 2-hour unit hydrograph was derived for the drainage area of 25.1 square miles above Bridgeport. As shown on Plate B-6, the unit hydrograph has a peak ordinate of 2,050 cfs, equivalent to 82 csm. Pertinent unit hydrograph data are as follows:

$$W_{50} = 6.0 \text{ hrs}$$

$$t_p = 3 \text{ hrs}$$

$$W_{75} = 3.3 \text{ hrs}$$

$$q_p = 82 \text{ csm}$$

The rainfall excess of the standard project storm was applied to the adopted unit hydrograph resulting in a standard project flood of 16,100 cfs. The standard project flood hydrograph at Boston Avenue is shown on Plate B-6.

c. Island Brook SPF. The standard project flood for Island Brook was developed by applying the average rainfall excess from the standard project storm to adopted unit hydrographs for the drainage areas above and below Lake Forest. The inflow hydrograph to Lake Forest was routed through the surcharge storage and combined with the flood hydrograph from the lower area. The resulting standard project flood for Island Brook at the mouth has a peak ordinate of 1,200 cfs and its contribution to the peak flow in the Pequonnock River is 700 cfs.

FLOOD CONTROL PLAN

11. GENERAL

Flood damage areas in the Pequonnock River basin extend from Trumbull downstream to tidewater in Bridgeport, with the greatest concentration in the lower reach. The recommended flood control plan for the basin was developed from studies of both local protection and reservoir projects. The most feasible plan was found to be a multiple-purpose dam and reservoir project which will provide for development of the water resources for recreation, water supply, low flow augmentation and flood control. Local protection projects which were studied but not recommended are described in Appendix H.

12. RECOMMENDED PLAN

a. Trumbull Pond Dam and Reservoir. Trumbull Pond Dam and Reservoir, shown on Plates 2 and 3 of the main report, is located on the Pequonnock River about 5 miles upstream of Bunnells Pond dam. The stream pattern is basically that of a single stream with steep

slopes which are conducive to rapid runoff during periods of intense rain or snow melt. A reservoir profile is shown on Plate B-2.

The dam and reservoir would control a drainage area of 14 square miles and have a flood control storage capacity of 5,980 acre-feet, equivalent to 8.0 inches of runoff. Principal features of the multiple-purpose dam and reservoir are as follows:

(1) Dam. The dam would be constructed of rolled earth-fill with top at elevation 285 feet msl. The dam would have a maximum height and length of 129 and 750 feet, respectively.

(2) Spillway. A chute spillway would be located east of the dam and have a 200-foot concrete ogee weir at elevation 270 feet msl. The discharge channel would be 1,100 feet long and converge from 200 feet to a constant width of 50 feet.

(3) Outlet works (flood control). An ogee weir intake would be located on the east abutment of the dam with a 48-inch conduit about 310 feet long. The weir and conduit would be at elevations 244 and 239 feet msl, respectively.

(4) Intake tower (water supply). An intake tower divided into two chambers would be provided with 5 intake gates in each chamber.

(5) Outlet works (water supply). A 30-inch conduit from each intake chamber would terminate at the downstream side of the dam with 30-inch gate valves for water supply and 8-inch Howell-Bunger valves for releases for water quality control.

Details of the above mentioned flood control and water supply features are presented in Appendix D. Pertinent project elevations and capacities are shown in Table B-5.

b. Spillway design flood. The spillway design flood represents the most severe condition of runoff that would result from the probable maximum precipitation falling on ground saturated from previous rains. Concurrently, it is assumed that the flood control portion of the reservoir initially contains 6 inches of flood runoff as a result of previous storms and that the water supply and low flow pools are full.

TABLE B-5

PERTINENT RESERVOIR DATA

<u>Feature</u>	<u>Maximum Elevation</u> (ft, msl)	<u>Capacity</u> (acre-feet)	<u>Equivalent Runoff</u> (inches)
Dead Storage	184.0	600	0.8
Water Supply Pool	237.0	5850	7.8
Low Flow Pool	244.0	1350	1.8
Flood Control Pool	270.0	5980	8.0
Surcharge Storage	280.0 (10 feet)		
Top of Dam	285.0 (5 feet, freeboard)		

A 3-hour unit hydrograph was derived for the drainage area of 14.0 square miles above the dam. The unit hydrograph has a peak discharge of 1,800 cfs and a lag time of 3.25 hours.

Values of rainfall for the probable maximum storm were obtained by applying a basin "size-shape" reduction factor to the values from USWB Hydrometeorological Report No. 33, as recommended in OCE letter, dated 10 April 1964, subject: "Hop Brook Dam and Reservoir, Hop Brook, Housatonic River Basin, Connecticut, Design Memorandum No. 1 - Hydrology." As recommended in the referenced letter, for a drainage area of 14.0 square miles, a basin "size-shape" reduction factor of 18.8% was applied to the Report No. 33 values and the probable maximum precipitation was determined as follows:

<u>Duration</u> (hours)	<u>Probable Maximum Precipitation</u> (HMS Report No. 33)	<u>18.8% Reduction Factor</u> (inches)	<u>Adjusted Precipitation for 14.0 sq. mi.</u> (inches)
6	23.4	4.4	19.0
12	26.2	4.9	21.3
24	28.3	5.3	23.0

The most intense 6-hour rainfall amount was subdivided into two 3-hour amounts with 67 percent of the 6-hour total in the maximum 3-hour period. Rainfall intensity was assumed to be uniform during the 3-hour periods. Losses from infiltration, surface detention, and transpiration were assumed at a rate of 0.1 inch per hour

which is consistent with minimum losses determined in previous studies for the New England area.

The rainfall excess of the probable maximum storm (shown below) was applied to the adopted unit hydrograph to yield the spillway design flood inflow.

Probable Maximum Precipitation (24 hrs.)	23.0 inches
Losses	<u>2.4</u>
Rainfall Excess (24 hrs.)	20.6 inches
Maximum 3-Hour Rainfall Excess	12.4 inches

The peak of the spillway design inflow was 27,800 cfs. The inflow was routed through storage using the capacity curve and the spillway rating curve for a length of 200 feet. The resulting maximum spillway design discharge was 23,200 cfs with a maximum water surface at elevation 280 feet msl, equivalent to 10 feet of surcharge. Discharge through the ungated outlet was relatively small and was neglected in the routing computations.

c. Outlet discharge. With the reservoir at spillway crest, it is estimated that the uncontrolled outlet would discharge about 350 cfs, equivalent to 25 cfs per square mile. The time required to completely drain the flood control pool from spillway crest is about 10 days. However, six inches of flood control storage would be available in about seven days.

d. Channel capacity. The present minimum channel capacity of the Pequonnock River through the Trumbull area ranges from 400-600 cfs, and between Bunnells Pond Dam and Roosevelt Street Bridge varies from 800-1,000 cfs. Below Roosevelt Street Bridge the channel capacity is dependent upon the coincident tide condition and varies from 1,500 to 2,500 cfs.

e. Recreation pool. The weir at the entrance to the flood control outlet will limit the maximum pool stage for water supply, low flow augmentation, and recreational purposes. The pool will be utilized for boating and fishing.

f. Effect of reservoir regulation. The flood control outlet for Trumbull Pond dam will be ungated; hence, regulation will be automatic and the reservoir will act as a detention basin in the event of a flood. The effect of Trumbull Pond Reservoir on the

standard project flood at Bridgeport is shown on Plate B-6. The natural SPF peak discharge of 16,100 cfs would be reduced to 7,700 cfs. In a recurrence of the record flood of October 1955, the reservoir would effect a reduction of 2,200 cfs, resulting in a modified peak discharge at the Boston Avenue bridge of about 3,600 cfs.

13. OTHER PROJECTS STUDIED

a. General. Consideration was given to other plans of improvement which would confine the Pequonnock River and Island Brook within walls and dikes in Bridgeport, both with and without Trumbull Pond Dam and Reservoir. These plans are shown and described in Appendix H.

The designs of the various improvements were based on containing natural and modified (by Trumbull Dam and Reservoir) discharges ranging from the maximum flood of record to the standard project flood. The values of these discharges are shown on Table B-6.

TABLE B-6

<u>River</u>	<u>DESIGN DISCHARGES</u>					
	<u>LOCAL PROTECTION PROJECTS</u>				<u>Oct. 1955 Flood</u>	
	<u>S.P.F.</u>		<u>P.D.F.</u>		<u>Nat.</u>	
	<u>Nat.</u>	<u>Mod.</u>	<u>Nat.</u>	<u>Mod.</u>	<u>Nat.</u>	<u>Mod.</u>
	<u>c.f.s.</u>	<u>c.f.s.</u>	<u>c.f.s.</u>	<u>c.f.s.</u>	<u>c.f.s.</u>	<u>c.f.s.</u>
Pequonnock River	16,100	7,700	12,200	5,800	5,800	3,600
Island Brook	1,200	1,200*	900	900*	600	600*
Confluence (Pequonnock R. & Island Brook)	16,800	8,700	12,800	6,500	6,200	4,000

*Trumbull Dam and Reservoir does not affect discharge on Island Brook.

b. Project design floods. The estimated maximum capacity of the existing box culvert downstream of Boston Avenue in Bridgeport is 5,800 cfs. Any modification to this culvert to increase its discharge capacity was considered impractical since the structure is comparatively new and passes under buildings of a shopping center.

A local protection plan with Trumbull Pond Dam and Reservoir as a project feature was considered using a project design flood of 12,200 cfs, which is 75 percent of the SPF (16,100 cfs) and twice the

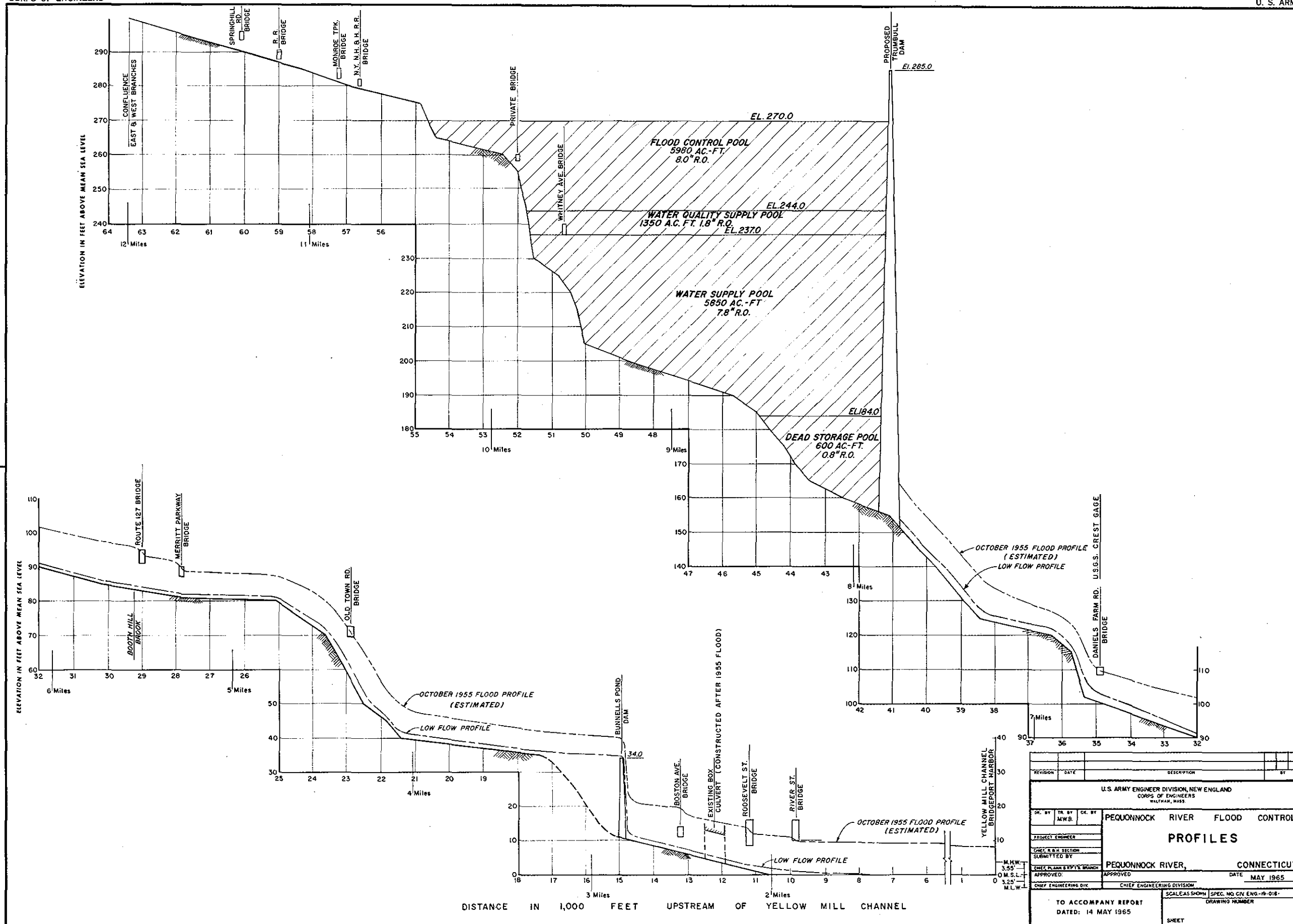
flood of record. Trumbull Pond Dam and Reservoir would reduce a discharge of 12,200 cfs at Boston Avenue to 5,800 cfs.

Local protection for Bridgeport without Trumbull Pond Dam and Reservoir as a project feature was also studied for a project design discharge of 5,800 cfs which is equal to the maximum flood of record.

Corresponding discharges on Island Brook and the Pequonnock River below the confluence are shown on Table B-6.

1

OVERSIZED
FOLDOUT



PEQUONNOCK RIVER FLOOD CONTROL
FLOW DURATION CURVES

TRUMBULL POND DAM

U.S. ARMY ENGINEER DIV., NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.

MEAN DAILY DISCHARGE IN C. S. M.

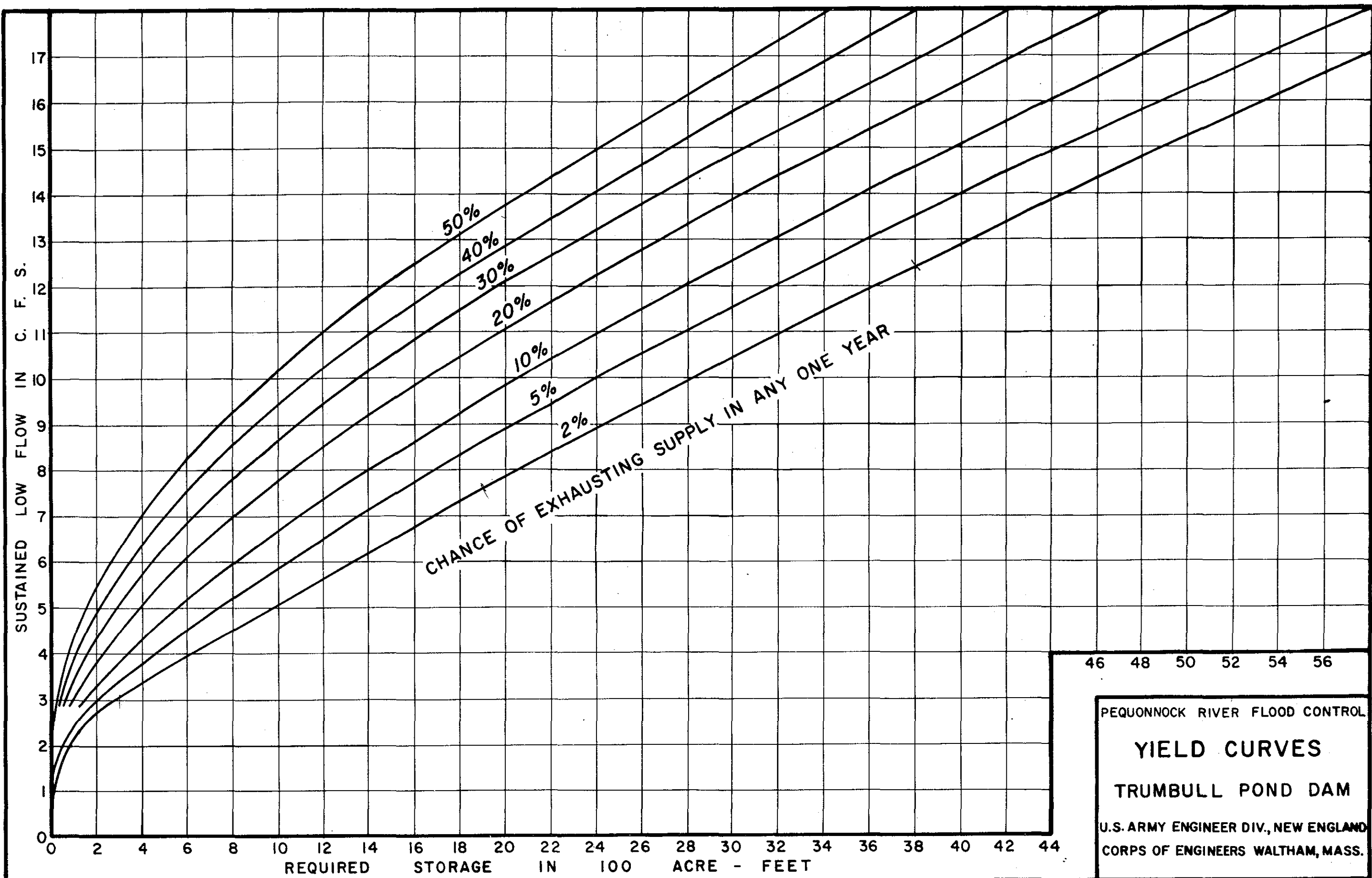
4
3
2
10.0
8
7
6
5
4
3
2
10
9
8
7
6
5
4
3
2
10.0

STILL RIVER
AT LANESVILLE
D.A. = 68.5 SQ. MI.

POMPERAUG RIVER
AT SOUTHBURY D.A. = 75.3 SQ. MI.

(Used as index station
for PEQUONNOCK RIVER)

PERCENT OF TIME MEAN DAILY FLOW WAS
EQUALED OR EXCEEDED

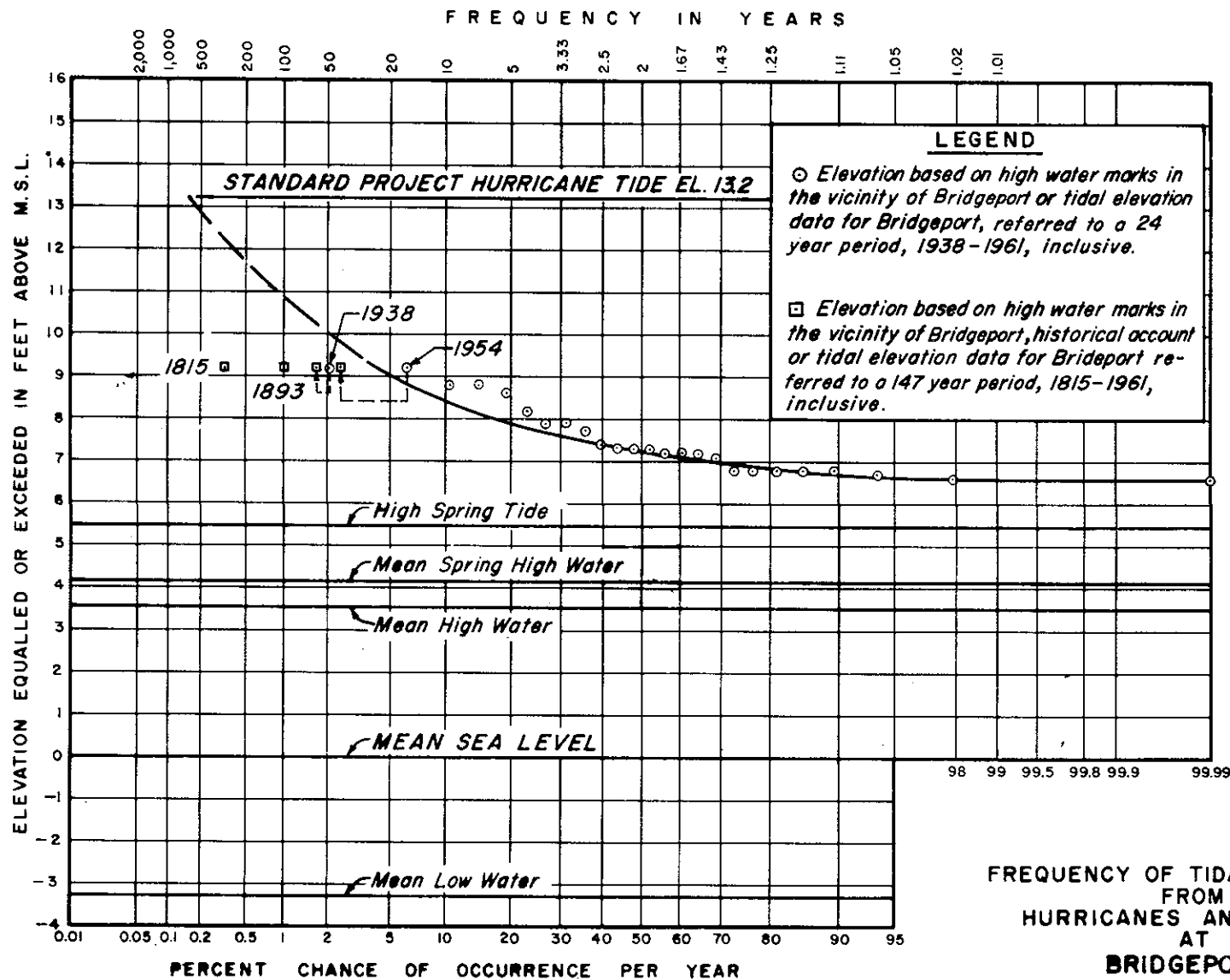


PEQUONNOCK RIVER FLOOD CONTROL

YIELD CURVES

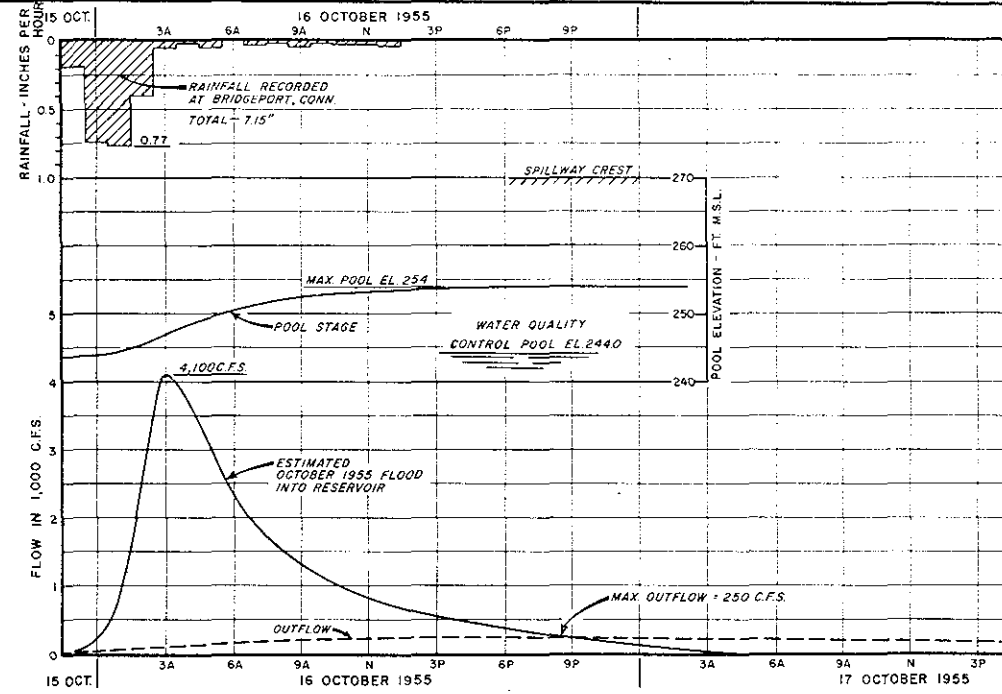
TRUMBULL POND DAM

U.S. ARMY ENGINEER DIV., NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.

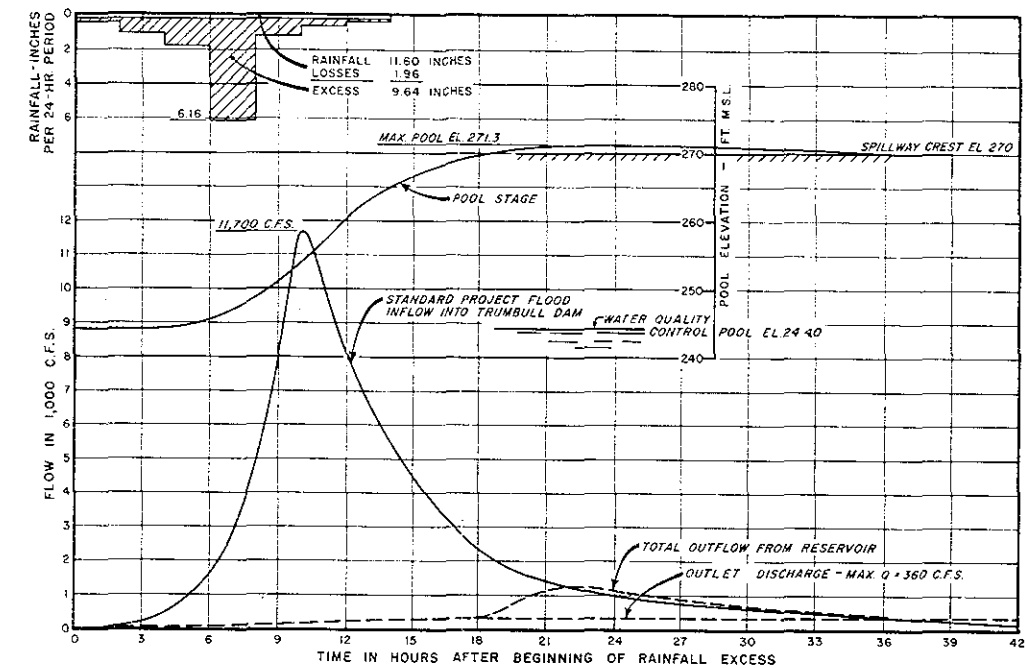
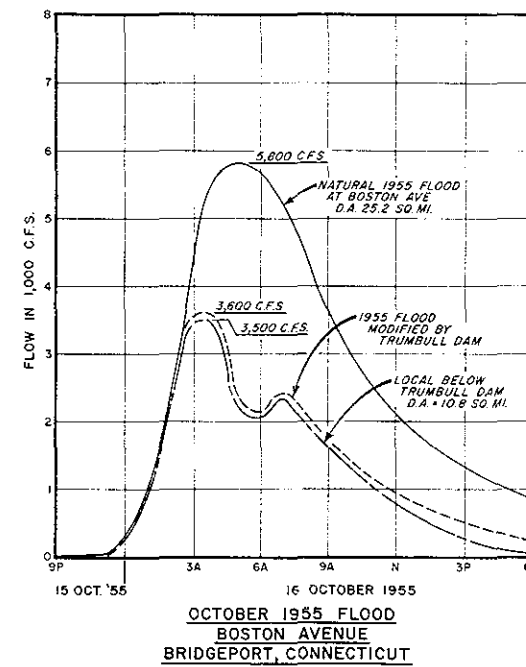
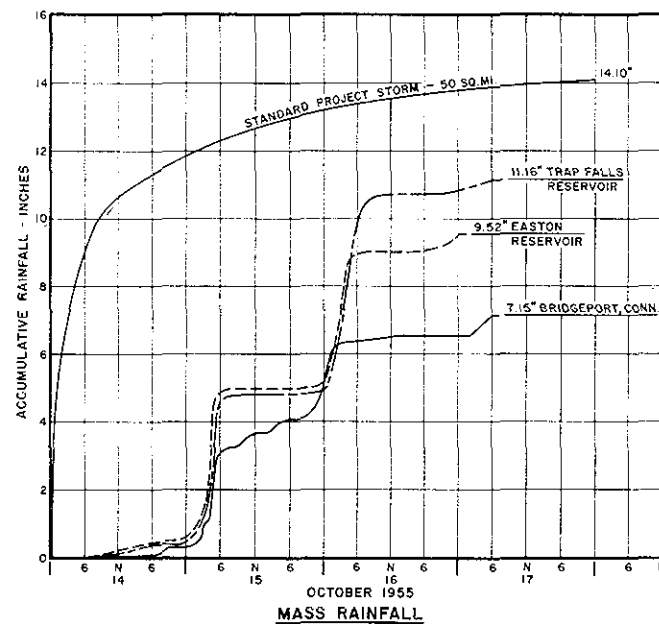


**FREQUENCY OF TIDAL FLOODING
FROM
HURRICANES AND STORMS
AT
BRIDGEPORT**

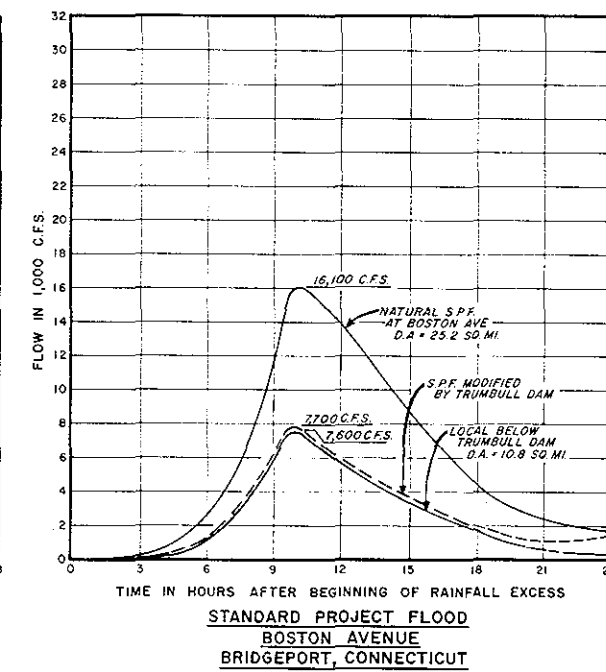
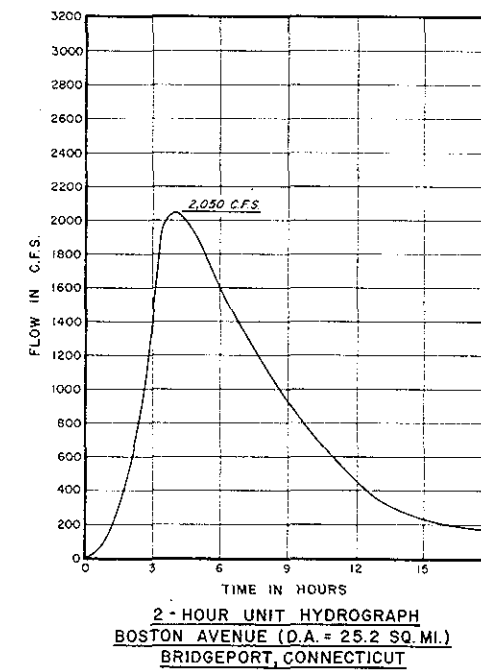
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS. FEB. 1963



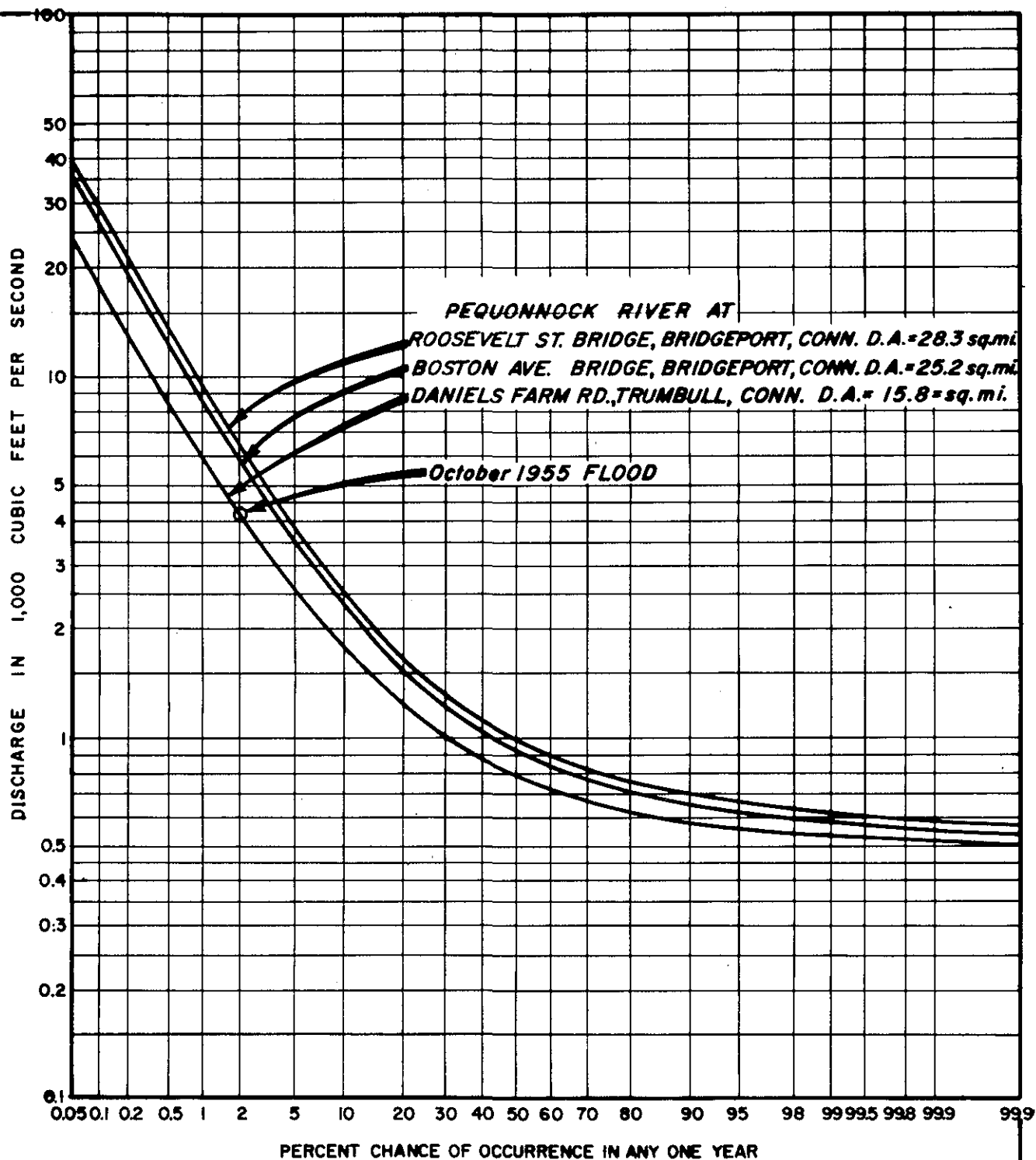
OCTOBER 1955 FLOOD
AT
TRUMBULL DAM, CONNECTICUT



STANDARD PROJECT FLOOD
AT
TRUMBULL DAM, CONNECTICUT



REVISION	DATE	DESCRIPTION	BY
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.			
OR BY	TR BY	CK BY	
PROJECT ENGINEER			
CHIEF	SECTION	PEQUONNOK RIVER, CONNECTICUT	
SUBMITTED BY	APPROVED	DATE	MAY 1965
CHIEF PLANN & RPT'S BRANCH	CHIEF ENGINEERING DIV.		
TO ACCOMPANY REPORT DATED: 14 MAY 1965		SCALE	SPEC NO. CIV. ENG. 19-116
		DRAWING NUMBER	
		SHEET	



PEQUONNOCK RIVER FLOOD CONTROL

DISCHARGE-FREQUENCY CURVES

U.S. ARMY ENGINEER DIV., NEW ENGLAND
CORPS OF ENGINEERS, WALTHAM, MASS.

PLATE NO. B-7

APPENDIX C
FLOOD LOSSES AND BENEFITS

APPENDIX C
FLOOD LOSSES AND BENEFITS

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APPENDIX C

FLOOD LOSSES AND BENEFITS

1. DAMAGE SURVEYS

A detailed damage survey was made in the main flood area of the Pequonnock River in Trumbull and Bridgeport, Connecticut in the summer of 1963 as part of a survey of all coastal streams in southern New England affected by the floods of 1955. The surveys consisted largely of door-to-door interviews, and inspections of the various residential, commercial, and industrial properties in the flooded areas. Information obtained included the extent of areas flooded, description of property, the nature and amount of damages, depths of flooding, high water references, and relationships between the October 1955 flood and other flood stages.

Damage estimates and depths of flooding were generally furnished by property owners and tenants, but investigators prepared alternative estimates when, in their judgment, estimates of owners or tenants were unrealistic or unreliable. The investigation also made estimates when information was not available from owners or tenants. Where several properties of similar type were subject to the same depth of flooding, sampling methods were used.

Sufficient data were obtained to derive loss estimates for (1) the October 1955 flood stage, (2) a stage 3 feet higher, and (3) intermediate stages where marked increase in damage occurred. The stage at which damage begins, referenced to the October 1955 flood stage, was also determined.

2. LOSS CLASSIFICATION

Flood loss information was recorded by type of loss and location. The types recorded include urban (residential, commercial and public), industrial and highway.

Primary losses were evaluated, including (1) physical losses, such as damage to structures, machinery, equipment and stock and cost of cleanup and repairs, and (2) non-physical losses such as unrecoverable losses of business and wages, increased cost of operation, and the cost of temporary facilities.

Physical losses and a large part of the related non-physical losses were determined by direct inspection of flooded properties and evaluation of the losses by either the property owners or field investigators or both. The non-physical portions of the primary losses were occasionally difficult to estimate on the basis of available information. When this difficulty existed, the non-physical losses were estimated by utilizing determined relationships between physical and non-physical losses for similar properties in the survey and other areas.

No evaluation was made of intangible losses including items such as possible loss of life, hazards to health, and detrimental effects on national security.

3. RECURRING LOSSES

A recurrence of the record flood of October 1955, in the Pequonnock Basin, under present conditions, would cause losses estimated at \$1,454,000. Losses would be incurred by 27 industrial establishments employing 832 people, 89 commercial establishments with employment of 1,410 people involved, 71 dwellings and some of the highways in the basin. Losses by types of loss are shown in Table C-1.

TABLE C-1

RECURRING 1955 LOSSES BY TYPES OF LOSS

Industrial	\$341,000
Urban (Commercial & Residential)	1,103,000
Highway	<u>10,000</u>
Total	\$1,454,000

The magnitude of recurring losses for stages of flooding above and below the record flood stage was determined to develop stage-damage curves for each subarea in the basin.

4. ANNUAL LOSSES

Estimated recurring losses were converted to annual losses by correlating stage-damage and stage-frequency data to derive damage-frequency relationships in accordance with standard Corps of Engineers

practices. Plates C-1 and C-2 show procedures used in converting recurring stage-damage data to a curve of damage-frequency. Estimated average annual losses in the reaches of the Pequonnock River below Daniels Farm Road amount to \$116,100 under current economic conditions.

5. TRENDS OF DEVELOPMENT

The Pequonnock River basin lies in the southeastern part of Fairfield County, Connecticut the fastest growing county in the state in the decade 1950-1960. The County, which abuts the northeastern edge of the burgeoning New York City S.M.S.A., had almost 26% of the State's population in 1960 although it occupies less than 13% of its land area. Per capita income in the County of \$3,271 (1959) was almost 20% higher than for the State as a whole and was 51% higher than the national average. The County had 28.4% of the State's "Value added by manufacturing," 27.3% of the dollar value of "Retail sales" and over 25% of the dollar value of "Selected services" in the State in 1958, the last year for which full data is available.

The Pequonnock basin communities have shared in the growth and prosperity of the county. In fact, percentage-wise, Trumbull had the greatest growth in population in the County in the 1950-1960 period, 136%. Connected to New York City, 56 miles to the southwest by the Connecticut Turnpike (Interstate Route I-95), the Merritt Parkway, and the Boston Post Road (Conn. -U.S. Route 1), and by the four-track, electrified main line of the New Haven Railroad, the basin is in the economic zone of interest of that metropolis. To the east and northeast, this same road and rail system connect the area to the principal population centers of southern New England, New Haven, Hartford, Providence, and Boston. To the north, State Routes 25 and 8 connect the basin to Danbury and to the industrial Naugatuck River Valley.

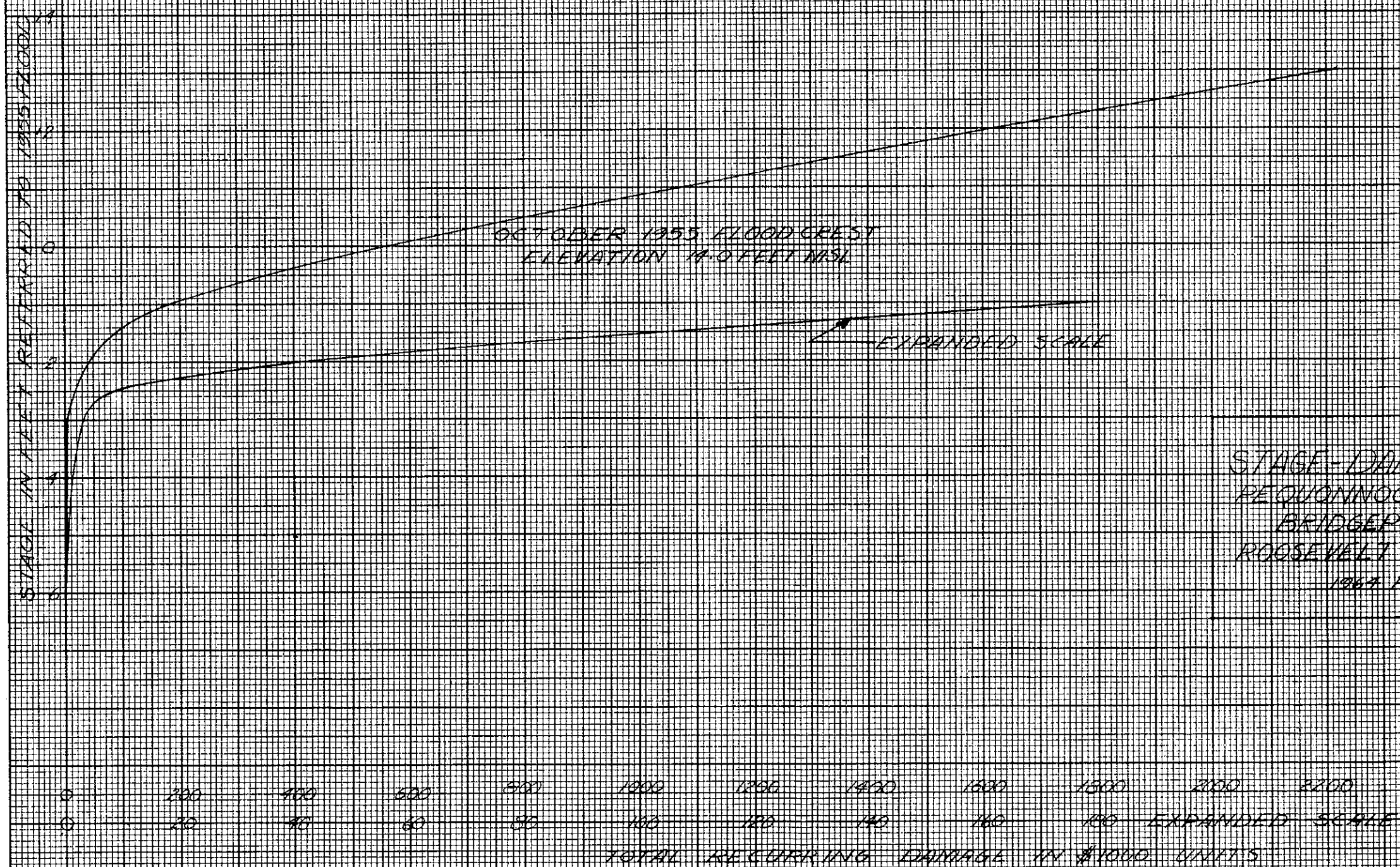
Land values are high in the basin; the asking price for a medium-sized parcel of land on the edge of the flood plain in Bridgeport was a dollar a square foot in late 1963 and the owner was not expecting to hold it long.

Based on the demand generated by the continuing growth in the area, it is reasonable to expect all the usable land in the flood plain in the Trumbull portion of the basin to be built over by 1970. In Bridgeport, most of the land is currently being put to high use and

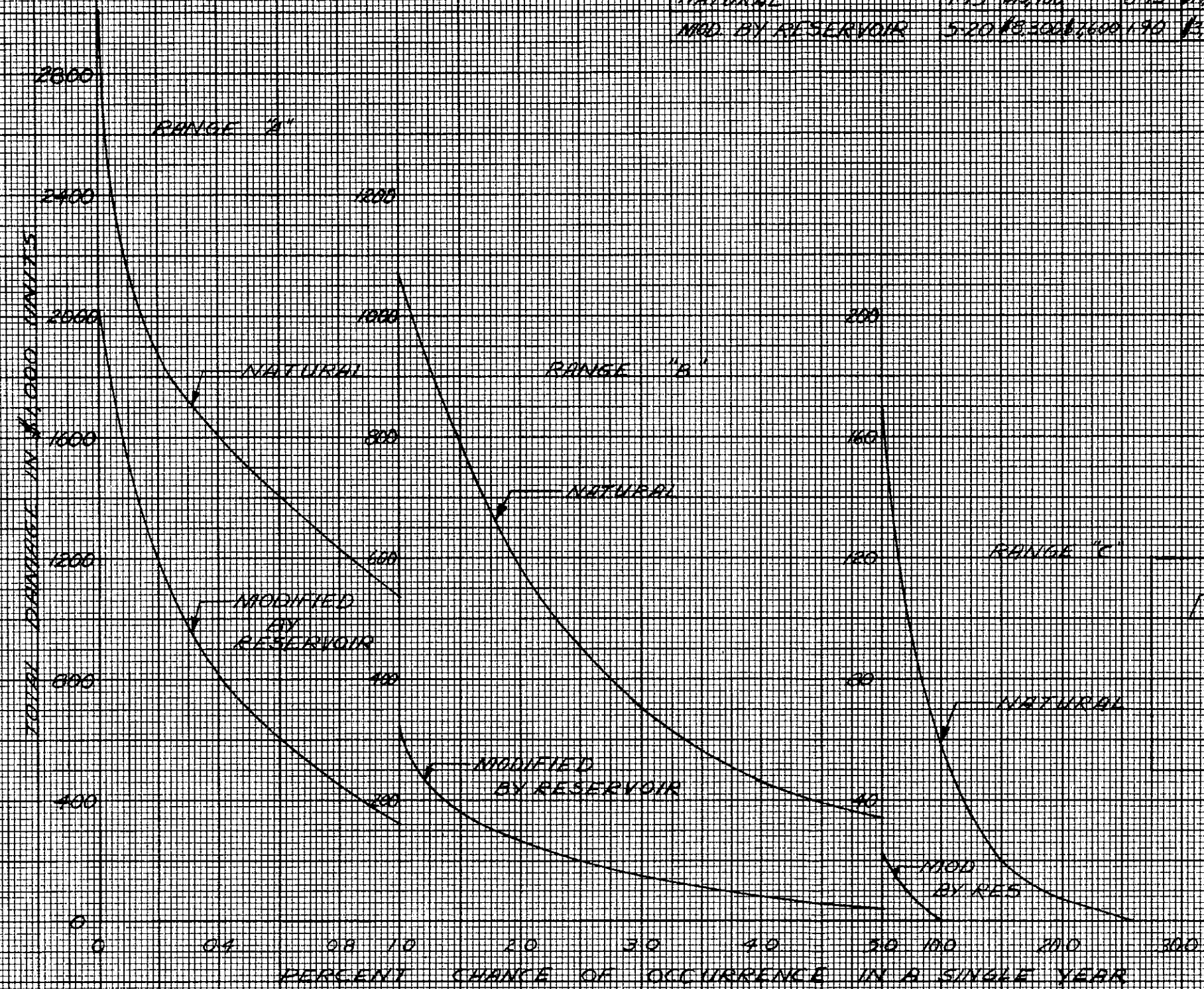
it is expected to continue in this use with one exception; some marginal type housing exists in the center of what is otherwise a completely commercial-industrial complex. The houses are old, small, and generally run down. Current demand for land in the area coupled with current land values makes it very unlikely that the houses will continue to occupy the land much beyond the present tenancy. It is to be expected that it will be converted to commercial usage by 1975. An appropriate adjustment was made in the annual losses to reflect the changes expected in land usage. In Trumbull, annual losses were increased in the ratio of total usable land area to present used land area. In Bridgeport, losses were increased by the difference in the unit square foot price for commercial losses in the area and the unit square foot price for residential losses multiplied by the residential area involved. The increase was discounted at 3-1/8% for the 5-year lag in time between the expected completion of the project in 1970 and the date when change in land use is expected to be completed. Adjusted annual losses amount to \$142,600 under 1970 conditions.

6. ANNUAL BENEFITS

Tangible average annual flood damage prevention benefits were derived as the difference between annual losses in the Pequonnock basin under conditions expected in 1970, and the annual losses remaining after construction of the recommended reservoir. Annual benefits so derived amount to \$100,700.



	RANGE "A"	RANGE "B"	RANGE "C"	TOTAL ANNUAL
	1" - \$1,600	1" - \$2,000	1" - \$4,000	
AREA LOSS BEN	AREA LOSS BEN	AREA LOSS BEN	AREA LOSS BEN	LOSS BEN
NATURAL	9.75 \$5,700 =	5.75 \$1,500 =	2.00 \$3,000 =	\$11,400
MOD. BY RESERVOIR	5.20 \$3,300 \$1,600	1.90 \$5,600 \$3,700	0.10 \$100 \$1,600	\$12,500 \$28,960



DAMAGE-FREQUENCY CURVE
 DEQUONNOK RIVER BASIN
 BRIDGEPORT, CONN.
 ROOSEVELT STREET AREA
 1961 PRICE LEVEL

APPENDIX D
RECOMMENDED PROJECT

APPENDIX D
RECOMMENDED PROJECT

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APPENDIX D

RECOMMENDED PROJECT

1. TRUMBULL POND DAM AND RESERVOIR

a. Water resources provisions. Present and anticipated needs for water resources development in the Pequonnock River basin make it desirable to construct a dam and reservoir to provide for flood control, water supply, and water quality control storage, and for recreational development. This can be accomplished in the basin at the Trumbull Pond site.

b. Location. The recommended Trumbull Pond damsite is located in the town of Trumbull, Fairfield County, Connecticut on the main Pequonnock River, about 3 miles upstream of the Merritt Parkway crossing. At spillway crest elevation, the reservoir would extend 2.5 miles upstream. Plates 2 and 3 in the main report present a reservoir map and general plan of the project.

c. Description of reservoir. The Trumbull Pond reservoir, at the combined water supply and low flow augmentation pool level of 244 feet, would extend over 2 miles upstream from the dam, have a surface area of 198 acres, and store 5,850 acre-feet (1.9 billion gallons) of water for domestic supply, 1,350 acre-feet (0.44 billion gallons) for water quality control and 600 acre-feet (0.2 billion gallons) of dead or sediment storage. At spillway crest elevation, 270 feet, mean sea level, the reservoir storage would total 13,780 acre-feet (4.5 billion gallons), including 5,980 acre-feet (1.95 billion gallons) for flood control equivalent to 8.0 inches of runoff from the drainage area of 14.0 square miles.

Details of the water supply and recreational features of the project are described in Appendices E and F of this report. The limits of the reservoir are shown on Plate 2 of the main report.

d. Description of dam. The dam, with top at elevation 285 feet, mean sea level datum, would be of rolled earth-fill construction, approximately 750 feet long and 129 feet in maximum height above the stream bed. A chute spillway, 200 feet long would be located in the east abutment of the dam. The spillway is designed for a 10-foot surcharge with 5 feet of freeboard between maximum design water surface elevation and top of dam.

e. Outlet works. The outlet works would consist of a separate flood control and water supply outlet systems. For the water supply outlet, a twin-chambered intake structure would take water from any of four levels into either chamber. Two 30-inch conduits would conduct the water from the intake tower under the dam to the downstream side, whence flows could pass into the water supply pumping station or be diverted for water quality control. Each pipe would have an 8-inch take off equipped with a Howell-Bunger valve for quality releases. In normal operation, only one chamber would be used at any one time for water supply, and releases for stream flow could be drawn through the bypass in the conduit leading from the other chamber, which could take in water from whatever level is desired. The reservoir could be completely emptied by gates located at the bottom of each chamber.

The flood control outlet would consist of a small weir at elevation 244 mean sea level at the entrance to an ungated 48-inch conduit on the east side of the dam.

2. GEOLOGY AND SOILS

a. Investigational program.

(1) Soils. An investigational program consisting chiefly of field reconnaissance and a review of available soils data was carried out to the extent considered necessary for this report. The purpose of this program was to determine the characteristics of the foundation soils, of the soils to be excavated during construction, and of the economically available embankment materials, and to develop a tentative embankment design.

(2) Site investigations. An alignment a short distance downstream was investigated through an advanced design stage for a concrete gravity dam by the Bridgeport Hydraulic Company commencing in 1949. Investigations included topographic survey at a scale of 40 feet to the inch and numerous subsurface explorations by geophysical means and by test borings. Geophysical explorations and test wells were also made in the basin upstream for potential development of subsurface water supply. Records for the explorations, except for random notations of depth or elevation to bedrock, are not available. Current field investigations have consisted of geologic reconnaissance in evaluation of sitings in the stretch of the river from the throat of the basin for a distance downstream of about 2,000 feet. The distribution of outcrops and surficial features from previous and current field work, and locations of applicable test borings and their available data are shown on Plate D-1.

b. Site geology. The damsite is at the upstream end of a narrow gorge cut in locally flat-lying schist bedrock, cubically and, secondarily, diagonally jointed, with prominent bedding planes and locally very micaceous. Bedrock is exposed abundantly on the east or left side and in many places on the valley floor east of the stream. The stream hugs the west or right side of the valley and bedrock is exposed intermittently along its west bank. The rock on the valley floor is water-worn with large potholes downstream which indicate that this gorge once was the base of a falls which migrated northward. Potholes also occur just downstream from the site on the side of the left valley wall. A side-hill, cut-and-fill railroad embankment obscures most of the toe of the natural slope of the west wall of the gorge throughout its length. Along the uphill (cut) side of the railroad embankment there are occasional outcrops with the hillside above till-veneered with numerous blocks. The alignment is closely downstream from the remains of the old, low reservoir dam. Part of the old embankment is still intact and just downstream on the left side of the river is a rock-fill or spoil pile, presumably from excavations for the old spillway. The valley floor near the pile is largely smooth outcrops, flush with the ground surface. The existing spillway has a rock floor and a steep, left wall of rock that rises about 80 feet above the floor. The rock here is massive and fairly sound, compared with exposures elsewhere in this reach. There are, however, several large talus blocks at the southerly end of the left abutment, between the downstream segments of the existing and proposed spillways. The rock surface on the right abutment and in the valley bottom is largely concealed by earth, but, where exposed, it is open-jointed and blocky. The right abutment slope is less sheer than that of the left abutment.

c. Foundation conditions. Bedrock is exposed or at shallow depths on the abutments and may be accessible in the stream section for construction of a cut-off for the embankment throughout the alignment. Nearly horizontal foliation coupled with major close-jointing trending with and across the river makes for seepage paths that will require thorough grouting for control. This rock structure also results in a semi-detached and detached blocky condition that will require removal and much clean-up in general in foundation preparations for structures and embankment. Jointing will greatly influence structure excavations, but in massive sections the near-horizontal foliation should assist in making near precise cuts where required. Although the schist is susceptible to weathering particularly in its more micaceous phases, there is no apparent problem in providing adequate bearing for structures. Rock structure and condition is generally displayed in site photographs shown as Figure D-1.



LOOKING EASTERLY AT LEFT ABUTMENT
SHOWING JOINT FACES AND OPEN FOLIATION
IN THE VICINITY OF FLOOD CONTROL OUTLET CHANNEL



LOOKING NORTH IN OLD SPILLWAY CHANNEL
FROM ABOUT PROPOSED CENTERLINE
SHOWING STEEP ROCK FACES OF LOWER LEFT ABUTMENT
IN THE BACKGROUND

BEDROCK EXPOSURES
TRUMBULL POND DAMSITE
PEQUONNOCK RIVER BASIN, CONNECTICUT

FIGURE D-1

d. Reservoir leakage. The reservoir area is a rock-rimmed and till-veneered basin. As far as can be determined from surficial geology and from available subsurface data by the seismic method, there are no deep subterranean outlets.

e. Characteristics of foundation soils. As indicated on Plate D-1, the overburden in the foundation area of the dam is shallow and frequently interrupted by outcropping of bedrock. Surficial evidence indicates that these soils consist of variable silty sands and gravels and glacial till deposits of gravelly silty sand. Except for a thin capping of topsoil, the foundation soils appear to be of types exhibiting high shear strength, low compressibility, and permeabilities varying from low to moderately high. The surface of the foundation area contains numerous large blocks and boulders.

f. Construction materials.

(1) Impervious embankment materials. Impervious material in the form of glacial till occurs along the left valley wall along the eastern slopes of the reservoir, but the local geology indicates shallow bedrock and numerous blocks in the till on the steep slopes. While till is very much in evidence in cuts near the site, the area is suburban and fairly heavily developed, and it may be necessary therefore to borrow till from as far away as 7 miles in a northerly direction where glacial till deposits of relatively well-graded sandy soils containing appreciable fines and a moderate percentage of gravel sizes are available. Materials of this type form compacted fills of low permeability and moderately high shear strength.

(2) Random embankment materials. Random embankment materials from the required excavations will consist principally of variable silty sands and gravels. Compacted fills of these materials are of high shear strength and variable permeability.

(3) Embankment drainage materials. No sources of highly pervious sands and gravel capable of economical development as borrow areas for embankment drainage materials and gravel bedding have been found near the project but these materials are available commercially from a location about 9 miles northwest of the site. As in other pits in the area, gravel components here are not plentiful and are mostly small size. Surficial conditions and seismic and test water well investigations by the Bridgeport Hydraulic Company indicate that much of the basin of the reservoir area contains gravelly materials.

(4) Rock. The rock to be excavated is highly foliated schist with a tendency to make flats and to fragment on blasting and handling. Selection and perhaps grizzlying will be necessary to obtain rock suitable for protection on the upstream slope. Operating trip and gneiss quarries are located about 20 miles north and east of the site.

(5) Aggregates. Several commercial sources of aggregates for concrete are located within a range of 9 to 20 miles.

g. Design of embankment.

(1) General. Typical sections of the dam embankment are shown on Plate 3 of the main report. In establishing the zonation of these sections, consideration was given to providing for the utilization of the random materials and rock materials from the required excavations and minimizing the relatively high costs of the contractor-furnished embankment drainage materials. The side slopes of the sections have been selected on the basis of experience with the design and construction of dam embankments of similar height and composition on similar foundations. Seepage through the embankment will be controlled by the wick drain and horizontal drainage blanket. An impervious foundation cutoff to bedrock will be provided to control seepage through the foundation soils.

(2) Foundation preparation. The existence of an abandoned rock cut spillway channel within the foundation area of the embankment for the proposed dam will require some foundation preparation measures beyond those normally employed. The left side of this spillway cut is a nearly vertical rock face up to 80 feet in height. For purposes of this report, a plan to flatten this face to 1 on 1 slope by rock excavation and to utilize the materials thus obtained in the rock-fill portions of the embankment is considered adequate.

3. REAL ESTATE

a. Character of the taking. Most of the land to be acquired in fee is undeveloped land, owned by the Bridgeport Hydraulic Company, the private utility holding a franchise to supply water within a service area including the Pequonnock River basin. Improvements within the reservoir area include 15 dwellings and 10 garages and outbuildings plus one commercial garage unit which will require acquisition and removal. Values of land and improvements have been based on the Market Data Approach, with loss in value through depreciation of a

leaching field as described in the next paragraph. The estimated land taking is based on the assumption that the Connecticut State Highway Commission will have completed the takings for the Route 25 relocation and the Whitney Avenue relocation as shown on Plate 2 of the main report, prior to construction of the reservoir project. The basis of taking is to elevation 270 feet plus 300 feet horizontally from full pool, a total of 525 acres in fee.

b. Severance. Experience in this type of acquisition has proven that severance damages occur when remaining ownerships are left with poor or no access. Severance damage will also occur to a home for the aged for which a large leaching field within the project area has recently been constructed, at a cost of \$55,000, on land leased by the institution from the Bridgeport Hydraulic Company. The taking of the field in fee will constitute a severance. The cost of this has been discounted for the loss in utility of the field over the period of its use prior to the completion date of the recommended project.

c. Mineral rights. Current field inspection revealed no mining operation of minerals within the proposed reservoir area.

d. Water rights. The value of the water rights of the Bridgeport Hydraulic Company is based on the consideration of the general water shortage in the Connecticut area and the need to extend present systems.

e. Resettlement. Resettlement costs, based on recent experiences, are estimated at \$600 for residential properties and \$1,500 for the commercial property. Processing resettlement claims are estimated at \$75 each.

f. Acquisition costs. Acquisition costs are also based on recent experience which indicates a cost of \$1,000 per ownership for the estimated 95 tracts involved in the acquisition.

4. COST ESTIMATES.

A breakdown of major construction items together with their estimated costs is given in Table D-1. (All tables are at the end of this appendix.) Table D-2 summarizes estimates of first costs and investments, and average annual charges for the recommended four-purpose project, including specific and joint-use costs, and for separate single-purpose and three-purpose projects computed for cost allocation purposes. In deriving the costs of alternative projects without water

supply, a recreation pool and development was computed which would realize the same benefits from unlimited recreation as the recommended project in which recreation is limited. Costs for a single-purpose water supply reservoir, discounted for the anticipated 5-year lag before first use, are derived in Table E-1 of Appendix E. Costs of the recommended project were allocated using the "Separable Costs-Remaining Benefits" method as shown in Table D-2. Table D-3 summarizes first costs, annual charges, and annual benefits and indicates the apportionment of costs among the several project purposes.

5. BENEFITS AND BENEFIT-COST RATIOS

As shown in Table D-3, total benefits accruing to the multiple-purpose project amply justify the total cost, and benefits to each of the project purposes of flood control, water supply, water quality control, and recreation exceed the costs allocated to these respective purposes. The derivation of discounted annual benefits to water supply is given in Table E-1 of Appendix E.

6. COST SHARING

a. General. The apportionment of costs between Federal and non-Federal interests is based on the provisions of pertinent legislation. Requirements of cost sharing for each function in the recommended project are discussed in the following paragraphs.

b. Flood control. Since the flood control aspects of the Trumbull Pond Dam and Reservoir provide wide-spread benefits, within the purview of the Flood Control Act of 1936 as amended, the apportionment of Federal cost will include all costs allocated to flood control.

c. Water supply. Under the provisions of the Water Supply Act of 1958 (Title III, Public Law 85-500), as amended, all costs allocated to water supply are reimbursable by local interests. The Bridgeport Hydraulic Company, the water company supplying the Bridgeport-Trumbull area, has indicated intention of participating in the development of the Trumbull Pond project as shown in their letter included as Exhibit I-8 of Appendix I.

Demand for additional water supply in the basin is expected to materialize within 5 years of the completion of the project. However, since the cost allocated to water supply is in excess of the 30 percent for future supply permitted by law, the Bridgeport Hydraulic

leaching field as described in the next paragraph. The estimated land taking is based on the assumption that the Connecticut State Highway Commission will have completed the takings for the Route 25 relocation and the Whitney Avenue relocation as shown on Plate 2 of the main report, prior to construction of the reservoir project. The taking would be to 3 feet above spillway crest elevation 270 or 300 feet horizontally beyond the 270 contour, whichever is greater, a total of 525 acres in fee.

b. Severance. Experience in this type of acquisition has proven that severance damages occur when remaining ownerships are left with poor or no access. Severance damage will also occur to a home for the aged for which a large leaching field within the project area has recently been constructed, at a cost of \$55,000, on land leased by the institution from the Bridgeport Hydraulic Company. The taking of the field in fee will constitute a severance. The cost of this has been discounted for the loss in utility of the field over the period of its use prior to the completion date of the recommended project.

c. Mineral rights. Current field inspection revealed no mining operation of minerals within the proposed reservoir area.

d. Resettlement. Resettlement costs, based on recent experiences, are estimated at \$600 for residential properties and \$1,500 for the commercial property. Processing resettlement claims are estimated at \$75 each.

e. Acquisition costs. Acquisition costs are also based on recent experience which indicates a cost of \$1,000 per ownership for the estimated 95 tracts involved in the acquisition.

4. COST ESTIMATES

A breakdown of major construction items together with their estimated costs is given in Table D-1. (All tables are at the end of this appendix.) Table D-2 summarizes estimates of first costs and investments, and average annual charges for the recommended four-purpose project, including specific and joint-use costs, and for separate single-purpose and three-purpose projects computed for cost allocation purposes. In deriving the costs of alternative projects without water

supply, a recreation pool and development was computed which would realize the same benefits from unlimited recreation as the recommended project in which recreation is limited. Costs for a single-purpose water supply reservoir, discounted for the anticipated 5-year lag before first use, are derived in Table E-1 of Appendix E. Costs of the recommended project were allocated using the "Separable Costs-Remaining Benefits" method as shown in Table D-2. Table D-3 summarizes first costs, annual charges, and annual benefits and indicates the apportionment of costs among the several project purposes.

5. BENEFITS AND BENEFIT-COST RATIOS

As shown in Table D-3, total benefits accruing to the multiple-purpose project amply justify the total cost, and benefits to each of the project purposes of flood control, water supply, water quality control, and recreation exceed the costs allocated to these respective purposes. The derivation of discounted annual benefits to water supply is given in Table E-1 of Appendix E.

6. COST SHARING

a. General. The apportionment of costs between Federal and non-Federal interests is based on the provisions of pertinent legislation. Requirements of cost sharing for each function in the recommended project are discussed in the following paragraphs.

b. Flood control. Since the flood control aspects of the Trumbull Pond Dam and Reservoir provide wide-spread benefits, within the purview of the Flood Control Act of 1936 as amended, the apportionment of Federal cost will include all costs allocated to flood control.

c. Water supply. Under the provisions of the Water Supply Act of 1958 (Title III, Public Law 85-500), as amended, all costs allocated to water supply are reimbursable by local interests. The Bridgeport Hydraulic Company, the water company supplying the Bridgeport-Trumbull area, has indicated intention of participating in the development of the Trumbull Pond project as shown in their letter included as Exhibit I-8 of Appendix I.

Demand for additional water supply in the basin is expected to materialize within 5 years of the completion of the project. However, since the cost allocated to water supply is in excess of the 30 percent for future supply permitted by law, the Bridgeport Hydraulic

Company will be required to agree to the following provisions of cost sharing prior to initiation of construction of the recommended project:

(1) To reimburse the United States that portion of the construction costs, including interest during construction, allocated to water supply amounting to 30 percent of the total first cost of the project, currently estimated at \$1,500,000, within 50 years after the project is first available for storage of water for any purpose, except that:

(a) No payment need be made with respect to storage for future water supply until such supply is first used, and

(b) No interest shall be charged on this amount until such supply is first used, but in no case shall the interest free period exceed 10 years.

(2) To pay that portion of the first cost of the project allocated to water supply over and above 30 percent of the project cost, an amount presently estimated at \$975,000 or 19.5 percent of the total project cost, said payment to be made either at the time of project construction or on an equivalent annual basis, including interest on construction and interest on the unpaid balance.

(3) To pay that portion of the cost for maintenance and operation of the project allocated to water supply, after such supply is first used - a portion presently estimated at \$15,000 annually, or 65.2 percent of the total annual project amount for maintenance and operation.

(4) After water supply is first used, to make payment, when incurred, of the allocated costs for major replacements, presently estimated at \$2,700 annually.

d. Water quality control. Storage for water quality control would realize benefits from reduction of adverse effects on water quality due to urban runoff or other waste discharges, and from incidental enhancement of downstream fishery and recreational resources. Costs for including water quality storage are non-reimbursable and are assigned to the Federal Government.

e. Recreation. Cost-sharing for the general recreational and fish and wildlife enhancement features of the project, based on H.R.

5269, introduced on 19 February 1965, and H. R. 9032, introduced on 6 November 1963, is shown in Table D-4. A summary of the pertinent provisions of H. R. 5269 and 9032 is given in paragraph 42 of the main report. Cost-sharing under previous Corps policy is also summarized in Table D-4.

TABLE D-1
FIRST COST
TRUMBULL POND DAM AND RESERVOIR
(1965 Price Level)

<u>Item</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
<u>1. LANDS AND DAMAGES</u>				
Lands		Lump sum		\$ 552,000
Improvements		" "		217,500
Water rights		" "		25,000
Severance		" "		35,000
Resettlement		" "		11,700
Contingencies		" "		93,800
				<u>\$ 935,000</u>
Acquisition				95,000
TOTAL - Lands and Damages				<u>\$1,030,000</u>
<u>2. RESERVOIR</u>				
Clearing	210	Ac.	\$300.	\$ 63,000
Structure removal		Lump sum		20,000
Contingencies				17,000
				<u>\$ 100,000</u>
Engineering and design				16,000
Supervision and administration				10,000
TOTAL - Reservoir				<u>\$ 126,000</u>

Company will be required to agree to the following provisions of cost sharing prior to initiation of construction of the recommended project:

(1) To reimburse the United States that portion of the construction costs, including interest during construction, allocated to water supply amounting to 30 percent of the total first cost of the project, currently estimated at \$1,500,000, within 50 years after the project is first available for storage of water for any purpose, except that:

(a) No payment need be made with respect to storage for future water supply until such supply is first used, and

(b) No interest shall be charged on this amount until such supply is first used, but in no case shall the interest free period exceed 10 years.

(2) To pay that portion of the first cost of the project allocated to water supply over and above 30 percent of the project cost, an amount presently estimated at \$975,000 or 19.5 percent of the total project cost, said payment to be made either at the time of project construction or on an equivalent annual basis, including interest on construction and interest on the unpaid balance.

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(4) After water supply is first used, to make payment, when incurred, of the allocated costs for major replacements, presently estimated at \$2,700 annually.

d. Water quality control. Storage for water quality control would realize benefits from reduction of adverse effects on water quality due to urban runoff or other waste discharges, and from incidental enhancement of downstream fishery and recreational resources. Costs for including water quality storage are non-reimbursable and are assigned to the Federal Government.

e. Recreation. Cost-sharing for the general recreational and fish and wildlife enhancement features of the project, based on H. R.

5269, introduced on 19 February 1965, and H. R. 9032, introduced on 6 November 1963, is shown in Table D-4. A summary of the pertinent provisions of H. R. 5269 and 9032 is given in paragraph 42 of the main report. Cost-sharing under previous Corps policy is also summarized in Table D-4.

TABLE D-1

FIRST COST
TRUMBULL POND DAM AND RESERVOIR
(1965 Price Level)

<u>Item</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
1. <u>LANDS AND DAMAGES</u>				
Lands		Lump sum		\$ 577,000
Improvements		" "		217,500
Severance		" "		35,000
Resettlement		" "		11,700
Contingencies		" "		93,800
				<u>\$ 935,000</u>
Acquisition				95,000
TOTAL - Lands and Damages				<u>\$1,030,000</u>
2. <u>RESERVOIR</u>				
Clearing	210	Ac.	\$300.	\$ 63,000
Structure removal		Lump sum		20,000
Contingencies				17,000
				<u>\$ 100,000</u>
Engineering and design				16,000
Supervision and administration				10,000
TOTAL - Reservoir				<u>\$ 126,000</u>

TABLE D-1 (cont'd.)

<u>Item</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
3. DAM				
Site preparation	35	Ac.	\$600	\$ 21,000
Stream control		Lump sum		6,000
Excavation, common	116,800	c.y.	1.00	116,800
Excavation, rock	122,000	c.y.	2.75	335,500
Impervious borrow	433,000	c.y.	1.40	606,200
Random borrow	167,000	c.y.	1.30	217,100
Sand borrow	41,000	c.y.	2.00	82,000
Gravel borrow	74,800	c.y.	2.25	168,300
Embankment placing	754,000	c.y.	0.25	188,500
Rock placing	116,000	c.y.	0.60	69,600
Foundation grouting		Lump sum		50,000
Mass concrete	4,060	c.y.	40.00	162,400
Reinforced concrete	2,005	c.y.	80.00	160,400
Drainage (dike)		Lump sum		25,000
Gates & valves		" "		71,000
Heating system		" "		2,500
Traveling crane		" "		15,000
Electrical work		" "		45,000
Lock joint pipe				
30" (water supply)	1,500	l.f.	50.00	75,000
48" (flood control)	350	l.f.	60.00	21,000
Structural steel	76,000	lb.	0.35	26,600
Misc. metals		Lump sum		3,000
Road oil	15,000	gal.	0.20	3,000
R. C. pipe, 24"	230	l.f.	10.00	2,300
Guard rail, rustic	1,700	l.f.	2.00	3,400
Guard rail, aluminum	450	l.f.	18.00	8,100
Contingencies				535,300
				<u>\$3,020,000</u>
Engineering and design				478,000
Supervision and administration				296,000
TOTAL - Dam				<u>\$3,794,000</u>

TABLE D-1 (cont'd.)

<u>Item</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
4. <u>RECREATION FACILITIES</u>				
Recreation facilities				\$ 40,000
Engineering and design				6,000
Supervision and administration				4,000
TOTAL - Recreation facilities				<u>\$ 50,000</u>
TOTAL PROJECT FIRST COST				<u>\$5,000,000</u>

TABLE D-2

COST ALLOCATION
TRUMBULL POND DAM AND RESERVOIR
 (All costs in \$1,000 at 1965 price level)

MULTIPLE PURPOSE PROJECT					THREE-PURPOSE PROJECTS					ALTERNATIVE SINGLE-PURPOSE PROJECTS				
Item	SPECIFIC COSTS				Joint Use Costs	Total Costs	W.S.,	F.C.,	F.C.,	F.C.,	F.C.	W.S.	Rec.	L.F.
	FC	WS	Rec.	L.F. Reg.			L.F., & Rec.	L.F., & Rec.	W.S., & L.F.	W.S., & Rec.				
FIRST COST AND INVESTMENT														
Lands and damages	-	-	-	-	1,030	1,030	736	776	1,030	1,000	617	687	210	210
Dam and reservoir	-	-	-	-	3,134	3,134	1,631	1,604	3,134	2,780	1,513	1,400	1,080	900
Water supply outlets	-	588	-	-	-	588	577	0	588	578	0	643	0	0
Flood control outlet	92	-	-	-	-	92	0	100	92	86	90	0	0	0
Service bridge	-	106	-	-	-	106	106	0	106	106	0	230	0	0
Recreational facilities	-	-	50	-	-	50	50	50	0	50	0	0	50	0
Total First Cost	92	694	50	-	4,164	5,000	3,100	2,530	4,950	4,600	2,220	2,960	1,340	1,110
Interest during Constr.	3	21	2	-	130	156	97	79	155	144	69	93	42	35
Total investment	95	715	52	-	4,294	5,156	3,197	2,609	5,105	4,744	2,289	3,053	1,382	1,145
ANNUAL CHARGES														
Interest						161.1	99.9	81.5	159.5	148.3	71.5		43.2	35.8
Amortization						7.8	4.8	3.9	7.7	7.2	3.5		2.1	1.7
Maintenance and Operation						23.0	18.0	8.0	20.0	23.0	5.0		8.0	5.0
Major replacements						4.6	4.6	1.9	3.1	4.6	0.4		1.9	0.4
Total Financial Charges						196.5	127.3	95.3	190.3	183.1	80.4		55.2	42.9
Loss of taxes						13.8	10.0	9.4	13.8	13.0	8.5		2.8	2.8
Total Economic Charges						210.3	137.3	104.7	204.1	196.1	88.9		58.0	45.7
Allocation of Annual Charges														
Benefits	100.7	120.0	176.0	49.0		445.7								
Alternative costs	88.9	108.4	58.0	45.7		301.0								
Limit of benefits	88.9	108.4	58.0	45.7		301.0								
Separable costs	73.0	105.6	6.2	14.2		199.0								
Remaining benefits	15.9	2.8	51.8	31.5		102.0								
Ratio of rem. benefits--%	15.6	2.7	50.8	30.9		100.0								
Alloc. joint costs	1.8	0.3	5.7	3.5		11.3								
Total allocated costs	74.8	105.9	11.9	17.7		210.3								
Allocation of Loss of Taxes														
Separable costs	3.8	4.4	0	0.8		9.0								
Joint costs	0.8	0.1	2.4	1.5		4.8								
Total allocation	4.6	4.5	2.4	2.3		13.8								
Allocation of O & M														
Separable costs	5.0	15.0	3.0	0		23.0								
Joint costs	0	0	0	0		0								
Total allocation	5.0	15.0	3.0	0		23.0								
Allocation of Major Repl.														
Separable costs	0	2.7	1.5	0		4.2								
Joint costs	0.1	0	0.2	0.1		0.4								
Total allocation	0.1	2.7	1.7	0.1		4.6								
Allocation of Investment and First Costs														
Annual investment cost	65.1	83.7	4.8	15.3		168.9								
Total Investment Cost	1,987	2,555	147	467		5,156								
Total Allocated First Cost	1,927	2,477	143	453		5,000								
Benefit:Cost Ratios														
	1.35	1.13	14.8	2.77		2.12								

See Table E-1
Appendix E

TABLE D-3

SUMMARY OF BENEFITS AND COSTS AMONG PURPOSES
TRUMBULL POND DAM & RESERVOIR

	<u>First Cost</u>	<u>Annual Charges</u>	<u>Annual Benefits</u>	<u>Benefit: Cost Ratio</u>
Flood control	\$1,927,000	\$ 74,800	\$100,700	1.35
Water supply	2,477,000	105,900	120,000	1.13
Low flow	453,000	17,700	49,000	2.77
Recreation	<u>143,000</u>	<u>11,900</u>	<u>176,000</u>	<u>14.8</u>
Total	\$5,000,000	\$210,300	445,700	2.12

TRUMBULL POND DAM AND RESERVOIR
COST-SHARING FOR RECREATION
(Including Fish and Wildlife Enhancement)
(1965 Price Level)

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TABLE D-2

COST ALLOCATION
TRUMBULL POND DAM AND RESERVOIR
 (All costs in \$1,000 at 1965 price level)

MULTIPLE PURPOSE PROJECT					THREE-PURPOSE PROJECTS					ALTERNATIVE SINGLE-PURPOSE PROJECTS				
Item	SPECIFIC COSTS				Joint Use Costs	Total Costs	W.S.,	F.C.,	F.C.,	F.C.,	F.C.	W.S.	Rec.	W.Q.C.
	FC	WS	Rec.	W.Q.C.			W.Q.C., & Rec.	W.Q.C., & Rec.	W.S., & W.Q.C. & Rec.	W.S., & Rec.				
FIRST COST AND INVESTMENT														
Lands and damages	-	-	-	-	1,030	1,030	736	776	1,030	1,000	617	687	210	210
Dam and reservoir	-	-	-	-	3,134	3,134	1,631	1,604	3,134	2,780	1,513	1,400	1,080	900
Water supply outlets	-	588	-	-	-	588	577	0	588	578	0	643	0	0
Flood control outlet	92	-	-	-	-	92	0	100	92	86	90	0	0	0
Service bridge	-	106	-	-	-	106	106	0	106	106	0	230	0	0
Recreational facilities	-	-	50	-	-	50	50	50	0	50	0	0	50	0
Total First Cost	92	694	50	-	4,164	5,000	3,100	2,530	4,950	4,600	2,220	2,960	1,340	1,110
Interest during Constr.	3	21	2	-	130	156	97	79	155	144	69	93	42	35
Total Investment	95	715	52	-	4,294	5,156	3,197	2,609	5,105	4,744	2,289	3,053	1,382	1,145
ANNUAL CHARGES														
Interest						161.1	99.9	81.5	159.5	148.3	71.5	See Table E-1 Appendix B	43.2	35.8
Amortization						7.8	4.8	3.9	7.7	7.2	3.5		2.1	1.7
Maintenance and Operation						23.0	18.0	8.0	20.0	23.0	5.0		8.0	5.0
Major replacements						4.6	4.6	1.9	3.1	4.6	0.4		1.9	0.4
Total Financial Charges						196.5	127.3	95.3	190.3	183.1	80.4		55.2	42.9
Loss of taxes						13.8	10.0	9.4	13.8	13.0	8.5	2.8	2.8	
Total Economic Charges						210.3	137.3	104.7	204.1	196.1	88.9	58.0	45.7	
Allocation of Annual Charges														
Benefits	100.7	120.0	176.0	49.0		445.7								
Alternative costs	88.9	108.4	58.0	45.7		301.0								
Limit of benefits	88.9	108.4	58.0	45.7		301.0								
Separable costs	73.0	105.6	6.2	14.2		199.0								
Remaining benefits	15.9	2.8	51.8	31.5		102.0								
Ratio of rem. benefits--%	15.6	2.7	50.8	30.9		100.0								
Alloc. joint costs	1.8	0.3	5.7	3.5		11.3								
Total allocated costs	74.8	105.9	11.9	17.7		210.3								
Allocation of Loss of Taxes														
Separable costs	3.8	4.4	0	0.8		9.0								
Joint costs	0.8	0.1	2.4	1.5		4.8								
Total allocation	4.6	4.5	2.4	2.3		13.8								
Allocation of O & M														
Separable costs	5.0	15.0	3.0	0		23.0								
Joint costs	0	0	0	0		0								
Total allocation	5.0	15.0	3.0	0		23.0								
Allocation of Major Repl.														
Separable costs	0	2.7	1.5	0		4.2								
Joint costs	0.1	0	0.2	0.1		0.4								
Total allocation	0.1	2.7	1.7	0.1		4.6								
Allocation of Investment and First Costs														
Annual investment cost	65.1	83.7	4.8	15.3		168.9								
Total Investment Cost	1,987	2,555	147	467		5,156								
Total Allocated First Cost	1,927	2,477	143	453		5,000								
Benefit:Cost Ratios														
	1.35	1.13	14.8	2.77		2.12								

TABLE D-3

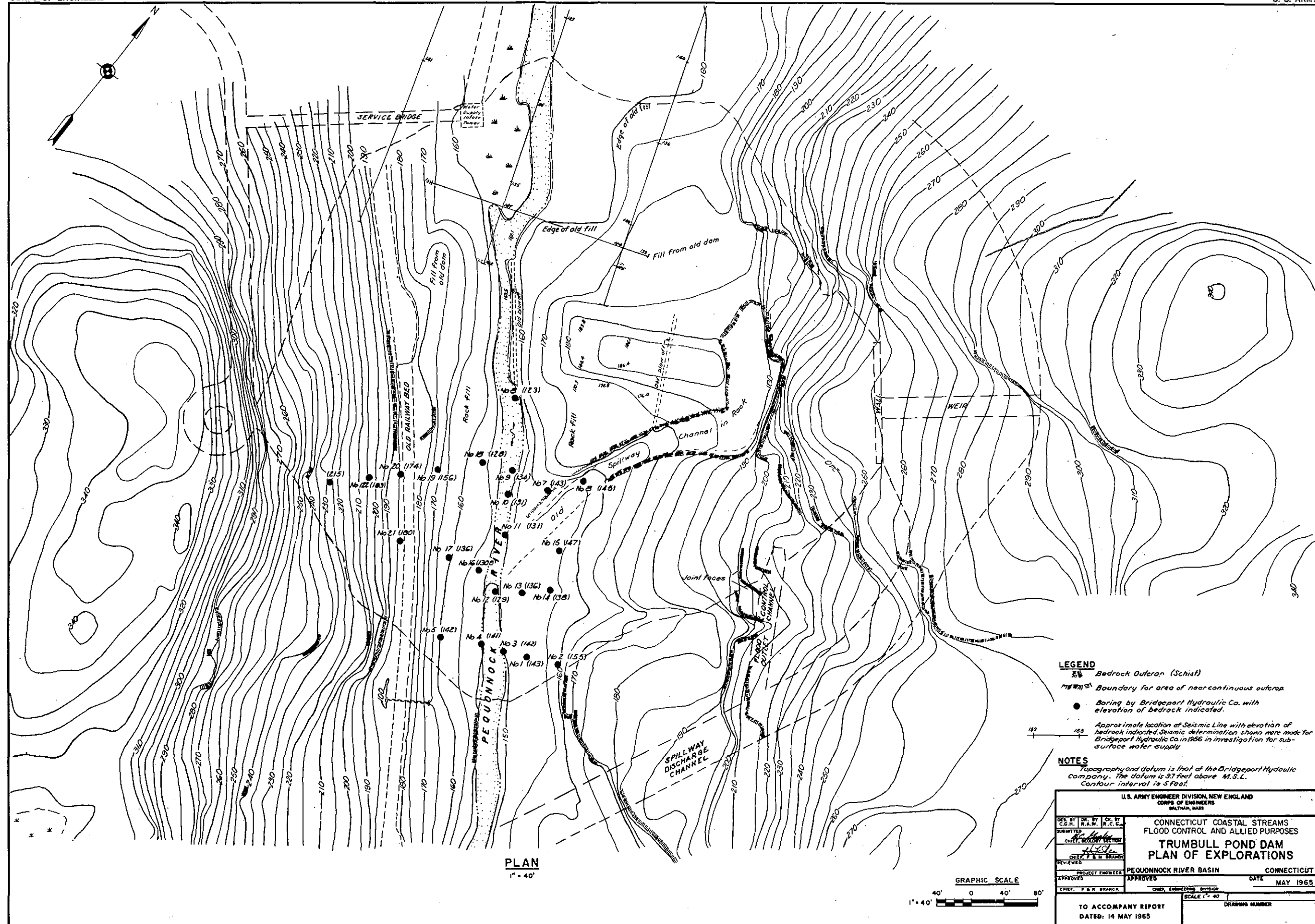
SUMMARY OF BENEFITS AND COSTS AMONG PURPOSES
TRUMBULL POND DAM & RESERVOIR

	<u>First Cost</u>	<u>Annual Charges</u>	<u>Annual Benefits</u>	<u>Benefit: Cost Ratio</u>
Flood control	\$1,929,000	\$ 74,800	\$100,700	1.35
Water supply	2,475,000	105,900	120,000	1.13
Water quality	453,000	17,700	49,000(1)	2.77
Recreation	<u>143,000</u>	<u>11,900</u>	<u>176,000</u>	<u>14.8</u>
Total	\$5,000,000	\$210,300	445,700	2.12

(1) Fishery benefits only; additional benefits anticipated from other aspects of stream regulation for water quality control.

TRUMBULL POND DAM AND RESERVOIR
COST-SHARING FOR RECREATION
(Including Fish and Wildlife Enhancement)
(1965 Price Level)

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APPENDIX E
WATER SUPPLY

APPENDIX E

WATER SUPPLY

Studies of potential yield at the proposed Trumbull Pond damsite are described in Appendix B. These studies, based on an analysis of the 28 years of flow record on the nearby Pomperaug River, indicate that a storage capacity of 4,400 acre-feet would provide the 9 million gallons daily (MGD) desired by the Bridgeport Hydraulic Company, with a statistical dependability of 98 percent. This storage is more than adequate to yield 9 MGD for the lowest flow period in the 28-year record. As the reliability of using the Pomperaug River records for the Pequonnock River is uncertain, the Bridgeport Hydraulic Company has requested a storage capacity of 5,850 acre-feet to insure sufficient capacity and to provide a small amount of reserve storage. Table E-1 outlines the method of determining annual water supply benefits and the annual costs of an equivalent, single-purpose water supply reservoir for cost allocation purposes, in accordance with standard Corps practice.

A report from the Division of Water Supply and Pollution Control, Public Health Service, Region I, Department of Health, Education, and Welfare, is also attached hereto. The water supply benefits derived by the Public Health Service differ slightly from those derived in Table E-1 due to differences in methodology and first costs used by the two agencies.

TABLE E-1

TRUMBULL POND DAM
SINGLE-PURPOSE WATER SUPPLY RESERVOIR

(To be built at Project Year 5 and serve as long as multiple-purpose project (95 years))

For Alternative Cost

First cost	\$2,960,000
Interest during construction ($\frac{1}{2} \times 2$ yrs. @ 3-1/8%)	93,000
Total Investment	<u>\$3,053,000</u>

Annual Charges

Interest (@ 3-1/8%)	\$ 95,400
Amortization (@ 3-1/8%, 95 yrs.) (0.001775)	5,400
Maintenance and operation	15,000
Loss of taxes	8,500
Major replacements (\$120,000 at years 25, 50, & 75)	
Present worth (@ 3-1/8%):	
25 years (\$120,000 x .46334) =	\$55,600
50 years (\$120,000 x .21469) =	25,800
75 years (\$120,000 x .09947) =	11,900
Total	<u>\$93,300</u>
Capital recovery (3-1/8%, 95 years):	
93,300 x .033025 =	3,100
Total annual charges (5 years hence) =	<u>\$127,400</u>
Total worth (5 years hence) = \$127,400 x 30.2798 =	3,858,000
Present worth = \$3,858,000 x .85740 =	3,308,000
Av. annual cost = <u>alt. cost</u> = \$3,308,000 x .03276 =	<u>108,400</u>

For Benefits

First cost	\$2,960,000
Interest during construction ($\frac{1}{2} \times 2$ yrs. @ 4%)	118,000
Total investment	<u>\$3,078,000</u>

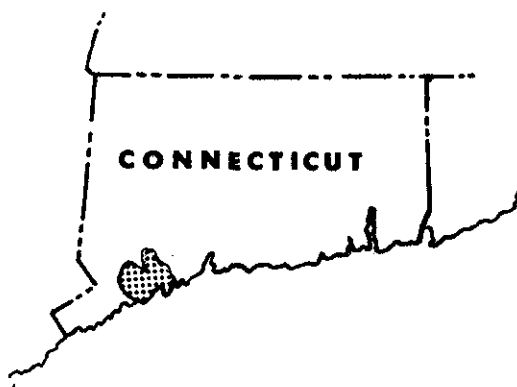
TABLE E-1 (cont'd.)

O&M and taxes (15,000 + 31,200) = 46,200	
Present worth (95 yrs. @ 4%) = 46,200 x 24.398 =	\$1,127,000
Major replacements (\$120,000 at years 25, 50 & 75)	
Present worth (@ 4%):	
25 years (\$120,000 x .3751) = \$45,000	
50 years (\$120,000 x .1407) = 17,000	
75 years (\$120,000 x .0528) = 6,000	
Total present worth, major replacements	68,000
Total worth at Project Year 5	\$4,273,000
Present worth at Project Year 0 (@ 3-1/8%)	
4,273,000 x .85740 =	\$3,664,000
Av. annual cost = <u>annual benefits</u> = 3,664,000 x .03276 =	120,000



**WATER SUPPLY
AND
WATER QUALITY CONTROL STUDY**

**PEQUONNOCK RIVER BASIN
CONNECTICUT**



**U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, REGION I
BOSTON, MASSACHUSETTS**

JANUARY 1965

WATER SUPPLY
AND
WATER QUALITY CONTROL STUDY
PEQUONNOCK RIVER BASIN
CONNECTICUT

The study reported on herein has disclosed a future need in the Bridgeport, Connecticut area for additional municipal and industrial water supplies of drinking quality. There is a potential need for water storage for water quality maintenance of the Pequonnock River which is not related to the discharge of treated municipal and industrial wastes. These conclusions are based on an analysis of available data and projections of population and industrial growth based on economic and demographic studies.

Prepared for
DEPARTMENT OF THE ARMY
U. S. Army Engineer Division, New England
Waltham, Massachusetts

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region I
Division of Water Supply and Pollution Control
Boston, Massachusetts

January 1965

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I INTRODUCTION

In a letter dated August 26, 1963, the U. S. Army Engineer Division, New England, requested the Department of Health, Education, and Welfare's advice "...as to any interest the Department of HEW might have and whether purposes other than flood control and recreation, including fish and wildlife, should be considered," in a potential multipurpose dam and reservoir on the Pequonnock River in Trumbull, Connecticut.

Authority

This study of the water resources of the Pequonnock River Basin has been made in accordance with (1) the Memorandum of Agreement dated November 4, 1958, between the Department of the Army and the Department of Health, Education, and Welfare, relative to Title III of the Federal Water Supply Act of 1958, as amended (42 U. S. C. 390b) and (2) the Federal Water Pollution Control Act, as amended (33 U. S. C. 466a (b)).

Purpose and Scope

A study of the water resources of the Pequonnock River Basin has been made to determine the need for and value of present and future municipal and industrial water supply and the need for and value of water storage for streamflow regulation for water quality control which could be wholly or partially satisfied by the proposed project. This study estimates water storage needs and values for a 100-year period from 1970 to 2070 in ten communities in southeast Fairfield County, Connecticut.

Acknowledgments

The assistance and cooperation of agencies and individuals who helped in the preparation of this report are gratefully acknowledged. Special thanks are extended to the State of Connecticut Water Resources Commission and Department of Health; Metcalf & Eddy, Consulting Engineers; Corps of Engineers, New England Division; U. S. Fish and Wildlife Service; and the management and staff of the Bridgeport Hydraulic Company.

II SUMMARY

1. This report describes the need for and value of water to the year 2070 for municipal and industrial water supply and for water quality control purposes which could be partially satisfied by water storage in the multipurpose Trumbull reservoir on the Pequonnock River in Trumbull, Connecticut being studied by the Corps of Engineers. The Pequonnock River Basin has a drainage area of 29 square miles of which 13.8 square miles will be controlled by the proposed project.

2. The study area consists of the Pequonnock River Basin and the surrounding area that is served municipal and industrial water by the Bridgeport Hydraulic Company. This area is in the southwest corner of Connecticut and includes the towns of Trumbull, Easton, Fairfield, Monroe, Redding, Shelton, Stratford, Weston, and Westport, and the city of Bridgeport.

3. The population of the study area in 1960 was 321,000 of which about 292,000 persons were supplied municipal water by the Bridgeport Hydraulic Company.

4. The per capita water use in the study area for a population of 314,000 in 1963 was about 175 gal/cap/day which resulted in an average daily demand of 55 MGD with industrial users accounting for about 40 per cent of this demand.

5. The Bridgeport Hydraulic Company water supply system has a present safe yield of 72.5 MGD of which 57.5 MGD is from various surface sources and the rest from presently developed ground water sources.

6. There are no significant waste discharges to the Pequonnock River at the present time. Minor amounts of septic tank drainage, drain field drainage to storm sewers, and land runoff are however received in the stream as evidenced by limited stream sampling data.

7. The Connecticut State Health Department has encouraged local development of a plan for future disposal of the areas treated sewage to Long Island Sound.

III CONCLUSIONS

1. Based on demographic and economic studies, it is expected that the total municipal and industrial water demand in the study area will be 150 MGD in the year 2020 and 212 MGD in 2070 to serve a population of 719,000 in 2020 and 940,000 in 2070. It is anticipated that 40 per cent of this demand will be for industrial use.

2. The proposed Trumbull Dam and reservoir can supply only 9.0 MGD of the 77.5 MGD additional water supply required by the year 2020. The minimum net value of water supply storage in the Trumbull Project to supply 9.0 MGD will be \$121,500 annually starting in 1970. This value would apply if releases of 290 acre-feet annually, with an annual value of \$4,600 are made to maintain minimum natural flows in the stream in order to protect present water uses.

3. The Water Supply benefits have been estimated by using the cost of the most likely alternate that would be used in the absence of the multipurpose project. The annual cost of the alternate includes annual taxes and operation and maintenance cost computed for the year 1975, the first year of water supply storage need, and discounted to 1970, the anticipated year of project completion.

4. Additional streamflow will be needed to control the effects of land drainage and urban runoff as the area becomes increasingly urbanized. Storage requirements for the project, however, cannot be ascertained until data are available from comprehensive water pollution control studies presently under way in the region.

5. Water Quality control benefits would be widespread both in area and purposes served. Recreational opportunities would be preserved and aesthetic values of an attractive stream would be maintained.

6. The value of benefits to be derived from streamflow regulation for water quality control as well as needed releases should be more fully evaluated at the design stage of the project.

IV LOCATION AND DESCRIPTION OF PROJECT

The proposed dam on the Pequonnock River is in Trumbull, Connecticut, approximately six and three-quarter miles above the river's mouth in Bridgeport Harbor. The project will have a permanent pool containing 7,800 acre-feet with a surface area of 200 acres at an elevation of 244 feet above mean seal level. In addition, 5,980 acre-feet of flood control storage is planned at a spillway crest elevation of 270 feet thereby forming a pool with a surface area of 268 acres. The flood-control storage provides for eight inches of runoff from a contributing drainage area of 13.8 square miles.

The drainage area has an average annual runoff of 24 inches as a result of an average annual precipitation of 46 inches. There are no gaging stations in the Pequonnock River Basin for determining the river's discharge and the terrain makes correlation of adjacent drainage areas very difficult. This lack of basic data hampered the quantitative results of the study with qualitative conclusions being made through discriminate use and analysis of the available data.

The Pequonnock River rises in the north central part of Monroe, Connecticut, and follows a meandering course in a general southerly direction for about 16 miles to Bridgeport Harbor, during which it falls nearly 440 feet while receiving the drainage from 29 square miles. In the town of Trumbull, the Pequonnock River flows through a section of steep hills and deep ravines before

reaching the city of Bridgeport where the river empties into Bridgeport Harbor. See Figure 2, following page 28.

V STUDY AREA

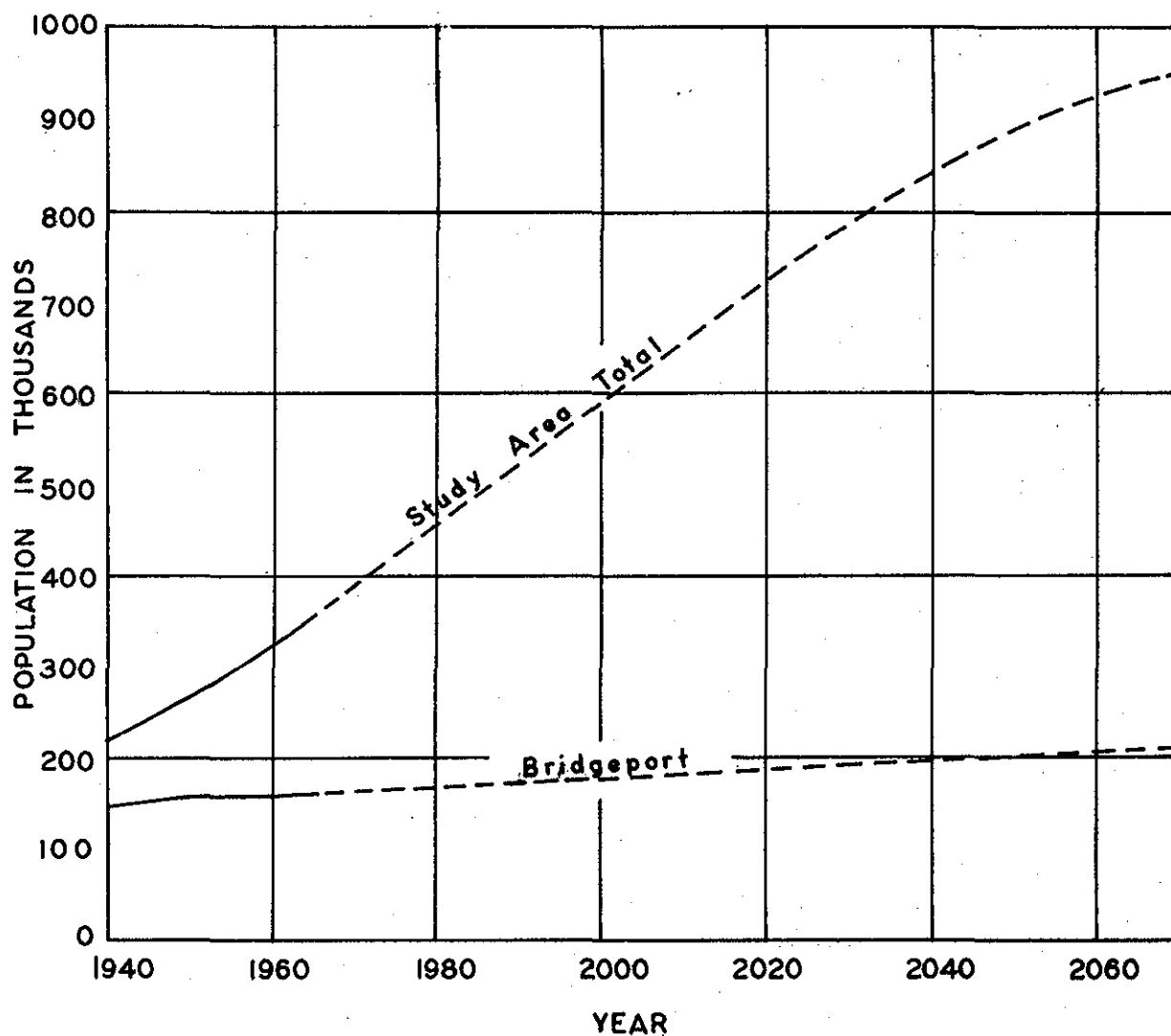
The area considered in the evaluation of the proposed multipurpose Trumbull Dam and Reservoir is the service area of the Bridgeport Hydraulic Company. This company supplies water of drinking quality to domestic and industrial users in the towns of Trumbull, Easton, Fairfield, Monroe, Shelton, Stratford, Weston, and Westport, and the City of Bridgeport. The town of Redding has also been included in the study area since by 1980 it will need a municipal water supply which would most logically be furnished by the Bridgeport Hydraulic Company. The drainage area of the Pequonnock River lies wholly within this service area. The service area of the Bridgeport Hydraulic Company was selected for study because any water supply storage provided in the Trumbull project would be utilized to meet the needs of the entire built-up area.

Economics

The city of Bridgeport is an industrial center for the manufacture of brass goods, machine tools, hardware, and firearms. 2/ It is the central city of a large population complex with the suburban communities surrounding Bridgeport being mainly residential in character. Bridgeport lies within commuting distance of New York City, and consequently, is strongly influenced by the same factors which affect New York City. The economy of Bridgeport is strong and is making significant gains through modernization and diversification.

Population

The population of the service area was 321,000 in 1960, with 156,748 and 20,379 being located in Bridgeport and Trumbull, respectively. The City of Bridgeport showed a decrease in population of 1.2% between 1950 and 1960, which was due primarily to large numbers of people moving to the suburbs. For instance, Trumbull had a 135.8% gain in population between 1950 and 1960, and the service area as a whole had a 22% gain. 3/ Due to continued industrial development and economic growth in the New York City and Bridgeport areas, the population of the Bridgeport Hydraulic Company's service area is expected to continue increasing to 726,000 in 2020, and 950,000 in 2070. The population projection for the study area as developed from the economic and demographic studies is shown in Figure I.



WATER SUPPLY AND WATER QUALITY CONTROL STUDY
PEQUONNOCK RIVER BASIN
CONNECTICUT

POPULATION PROJECTION

DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
Region I Boston, Mass.

FIGURE 1.

VI DEMAND FOR WATER

The demand for municipal and industrial water of drinking quality supplied by the Bridgeport Hydraulic Company in its service area has increased from 34.7 MGD in 1950 to 54.7 MGD in 1963, which is an increase of about 1.5 MGD per year. The increasing demand for water is a result both of the larger population being served each year and the growth in per capita consumption of water.

The per capita water use is expected to increase to about 210 gal/cap/day in 2020 and 225 gal/cap/day in 2070 from the current rate of 175 gal/cap/day. The increase in per capita consumption is based on the assumptions that high-rise apartment will furnish much of the needed future living space and no heavy water-using industry will locate in the area. Forty per cent of the company's present demand is for industrial water supply, and this proportion is expected to remain about the same in the future.

Approximately 91% of the total population within the study area was being served domestic water by the Bridgeport Hydraulic Company in 1960. The proportion served is expected to increase to 99% by 2020 as a result of the rising population density and corresponding decrease in use of private water wells.

After a thorough consideration of the factors affecting the demand for water in the Bridgeport area, it appears that a reasonable estimate of the demand for municipal and industrial water of drinking quality to be supplied by the Bridgeport Hydraulic Company would be as follows:

TABLE I
STUDY AREA PROJECTIONS

<u>Year</u>	<u>Area Population</u>	<u>Per cent Served</u>	<u>Per Capita Consumption gal./cap./day</u>	<u>Water Demand MGD</u>
1960	321,000	91	167	49
1980	456,000	94	186	80
2000	591,000	98	197	114
2020	726,000	99	210	150
2040	840,000	99	218	182
2070	950,000	99	225	212

These water requirements do not reflect a demand for water exercised by an industry which might desire to provide its own water supply. A large demand for such water is not anticipated because of the high development cost of an independent water supply. Small industrial water supplies may be developed through the use of ground water, but these would be strictly limited in quantity, and are therefore not included. It is expected, therefore, that all significant water users within the study area will be supplied by the Bridgeport Hydraulic Company.

VII WATER RESOURCES

The Bridgeport Hydraulic Company presently has a safe yield of 72.5 MGD, with 57.5 MGD being supplied from various surface sources and 15 MGD from wells. The system's major source of ground water is from the Housatonic well field which presently has a safe draft of 12 MGD. The company has many surface sources of supply throughout the service area, of which Saugatuck, Hemlocks, Easton, and Trap Falls reservoirs are the most significant.13/

The proposed Trumbull project is being planned for the development of 9.0 MGD for municipal water supply from a drainage area of 13.8 square miles. Presently the drainage from 3.8 square miles of the Pequonnock's watershed above the proposed Trumbull Dam site may be diverted to the Easton Reservoir in the adjoining watershed. Such an arrangement could reduce the yield from the Trumbull project but the yield from the combination of both reservoirs could result in increased yields. The Hydraulic Company plans on maintaining the diversion after the Trumbull Reservoir is completed in order to have operational flexibility so that either reservoir may be benefited by runoff from the upper watershed.

Future Ground Water

The Bridgeport Hydraulic Company has conducted an extensive search for additional ground water supplies, but this search has been unsuccessful in locating any sizeable quantities of new ground water sources. The Housatonic well field has an estimated ultimate development of 40 MGD, which constitutes an additional

development of 28 MGD. This is being carried out by the company on a step-by-step basis. The high cost of pumping indicates that it is more economical to provide surface sources of water supply within the service area rather than pump water from the Housatonic well field. Due to these economic factors, it is anticipated that all surface sources of water supply will be developed before the Housatonic well field is fully developed and the Trumbull project will be utilized by 1975.

Future Surface Water

The Trumbull Dam site is the last feasible location for the development of a surface water supply within the Bridgeport Hydraulic Company's service area around Bridgeport. The company owns most of the land to be inundated by the Trumbull Reservoir, and the company also owns diversion rights to the total flow of the Pequonnock River.

The Pequonnock River water is of relatively good quality except for bacteria, turbidity, and color contributed by surface runoff which would have to be removed to make the water suitable for drinking. Present plans indicate these undersirable qualities will be removed from the project water by sedimentation, filtration, and chlorination prior to pumping into the distribution system. Table 2 shows average values for several water quality parameters for the Pequonnock and Housatonic Rivers.

Including the addition of 9.0 MGD from the Trumbull Reservoir and 28 MGD from the Housatonic well field, the Bridgeport Hydraulic Company will have a safe yield of 109.5 MGD. This amount of water

will be needed before the year 2000. The only remaining major source of water supply is the Housatonic River which should be capable of furnishing ample water to meet additional future water demands. The water quality of the Housatonic River is relatively good at the site of the present well field where a future river intake would be constructed. Sedimentation, filtration, and chlorination or other suitable treatment would need to be provided for the river water obtained at this site to remove bacteria and turbidity. Downstream from this site is a major source of pollution from the Naugatuck River and the Towns of Shelton, Derby, and Ansonia. The water quality of the Housatonic River below its confluence with the Naugatuck River is degraded to the point that present water uses are restricted to certain industrial uses and transportation of wastes.

TABLE 2

WATER QUALITY DATA 13/
AVERAGE VALUES - 1964

	Pequonnock River		Housatonic River
	<u>Above Proj.</u>	<u>Below Proj.</u>	<u>Near Well Field</u>
Color (units)	26	23	21
Turbidity (units)	3	3	4
pH	7.1	7.1	7.5
Chloride (mg/l)	21	19.3	8.0
Iron (mg/l)	0.24	0.21	0.24
Total Hardness (mg/l)	57	47	88
Alkalinity (mg/l)	35	27	73
Nitrate as N (mg/l)	0.35	0.04	0.14
Total Solids (mg/l)	129	117	127
Coliform Bacteria (MPN per 100 ml)	5,000	14,800	1,300

Note: Averages represent the analysis by the Bridgeport Hydraulic Company of one grab sample for each location taken each month during 1964.

The Connecticut Light and Power Company at Stevenson, Connecticut, presently regulates the Housatonic River flows upstream of the area most likely to be developed by the Bridgeport Hydraulic Company for future water supply. 7/ 8/ It is expected, however, that when water is needed from the Housatonic River, satisfactory agreements on water releases will be made between the two utility companies.

It is concluded that the Bridgeport Hydraulic Company has adequate sources of supply to meet its present water demands, that in the future the company will need to develop additional sources of supply to meet the water demand generated by a growing population, and that there are adequate sources of water available for development. The proposed dam and reservoir on the Pequonnock River will provide an excellent opportunity for the Bridgeport Hydraulic Company to develop an additional source of water supply of 9 MGD.

Recreation and Water Supply

Recreational use of the proposed Trumbull Reservoir is being planned as a project purpose. Such use poses a potential hazard to the quality of the water stored in the reservoir for domestic use unless adequate measures are taken to prevent the pollution of the watershed and reservoir area. As recognition of the potential hazard, Connecticut law prohibits the use of domestic water supply reservoirs for water contact sports, 23/ and it has been the policy of the Connecticut State Department of Health to prohibit any recreational use of water supply reservoirs.

There is a current trend in the United States to use water reservoirs for more than one purpose including the combining of limited,

controlled recreation and water supply where the water from the reservoir receives suitable treatment before it is used for drinking. By legislation, recreation and water supply are both recognized and approved uses of Federally constructed reservoirs. Hence, the Public Health Service raises no objections to such uses provided necessary safeguards are applied to the watershed and reservoir areas when public water supplies are involved. Such safeguards require consideration of both the degree of treatment provided to the water for the production of domestic water, together with the establishment of pollution control measures to be applied to both the watershed and upstream reservoir areas.

In the Trumbull Project, only limited, well-controlled recreational activities such as boating, fishing, and picnicking are being considered for development. The Bridgeport Hydraulic Company has informed the Corps of Engineers that these activities "could be allowed without violating good water supply practice." The Hydraulic Company has also stated that the Corps of Engineers would have to be responsible for the construction, maintenance, and supervision of the recreational facilities.

The water stored in the Trumbull Reservoir is to be treated by sedimentation, filtration, and chlorination, thus preventing any pollution resulting from recreational use from reaching the water consumers. Based on information available at the present time, there does not seem to be any compelling reason why well-controlled, limited recreational use of the proposed water supply reservoir at Trumbull should not be permitted.

STREAMFLOW REGULATION FOR WATER QUALITY CONTROL

At the present time there are no important domestic or industrial waste discharges to the Pequonnock River.^{15/} The only major concentration of population along the upper Pequonnock River is located in Trumbull; but at this time, Trumbull does not have a sewerage system. The only domestic waste discharges to the river result from the leaching of septic tanks and drain fields into storm sewers discharging to the Pequonnock River. There are no known domestic or industrial wastes being discharged directly to these storm sewers; however, bacteriological samples collected from the Pequonnock River by the City of Bridgeport Health Department indicate that surface runoff through these storm sewers apparently creates a bacterial pollution problem.^{14/}

Future Waste Control

The Town of Trumbull has initiated preliminary planning for a separate domestic sewage collection system and treatment plant which would alleviate many of the above problems; but because of the many difficulties involved, no definite action has been taken. A possible site for a sewage treatment plant to serve Trumbull would be on the Pequonnock River near the boundary between Trumbull and Bridgeport, which would be downstream from the Trumbull Dam site. Such a sewage treatment plant would provide secondary treatment, and flow regulation would be needed to maintain stream quality, especially during periods of low flow. However, downstream of such a project, the Pequonnock River flows through the City of Bridgeport's Beardsley Park where

a small dam forms Bunnell's Pond. The pond is used for swimming, and the adjacent park land for picnicking, sunbathing, and other recreational purposes. Because of this recreational development, any plan to discharge sewage above Bunnell's Pond has been opposed by the city of Bridgeport and the Connecticut State Department of Health. Due to these objections, Trumbull's Consulting Engineer has recommended that an outfall sewer be built to carry the treatment plant's effluent downstream of Bunnell's Pond.^{18/} Such a line would be about $2\frac{1}{4}$ miles long and would discharge $2\frac{1}{4}$ miles above the mouth of the Pequonnock River in Bridgeport Harbor. If the outfall is proposed for construction, studies should be carried out to determine the effect of the treated sewage on the water quality of the Pequonnock River estuary.

To provide the greatest degree of public health protection and the most efficient sewerage system, the Connecticut State Health Department has encouraged the development of a regional sewerage plan for the Bridgeport-Trumbull Area. The objective of such a plan would be ultimate disposal of the area's treated sewage to Long Island Sound with provision for the discharge of Trumbull's sewage to a regional sewerage system. This would be the most satisfactory solution to Trumbull and the adjacent area sewerage problem. But institutional arrangements, financial difficulties, and technical problems pose obstacles to such a solution.

Notwithstanding difficulties, no future waste discharges of any importance to the Pequonnock River are anticipated. The city of Bridgeport's sewage treatment plants discharge to Long Island Sound,

and no sewage discharges by Bridgeport to the Pequonnock River are foreseen. Since most of the drainage area of the Pequonnock River has been developed as residential areas, no industrial waste discharges to the Pequonnock River are to be expected.

It is concluded from information presently available that in the Pequonnock River Basin there is no current need, nor is any need anticipated in the future, to provide water storage for stream-flow regulation in order to reduce waste concentrations and thereby prevent water quality deterioration due to the discharge of treated municipal and industrial wastes.

However it is expected that surface runoff will become an increasingly significant factor affecting the water quality of the Pequonnock River as the area becomes urbanized. As additional data on the wastes from urban runoff becomes available, further studies will need to be carried out to determine the effects of these wastes on the Pequonnock River.

Potential Water Quality Damages

At the present time, the Connecticut Board of Fisheries and Game leases land along the Pequonnock River between Beardsley Park and the proposed dam site. This area provides a natural habitat for fish and wildlife indigenous to the region and is also used for "put and take" pheasant hunting and trout fishing. This is a delightful area aesthetically and the recreational features are outstanding.

The proposed Trumbull Dam will alter considerably the Pequonnock River flows and seriously affect both the recreational facilities

and the aesthetic value of the area in general. During periods of low flow, which most often occur in the summer months, the runoff from 13.8 square miles of drainage area would be cut off by the proposed project. This would result in deterioration of water quality as well as reduce streamflow below the level necessary to maintain a suitable fish and wildlife habitat. Damages to water quality would include, but not be limited to, reduced dissolved oxygen levels, higher water temperatures, and the build-up of algae and bacteria, all of which would diminish the aesthetic character and beneficial uses of the river.

In order to prevent the accrual of damages to present water uses due to the Trumbull project, it will be necessary to provide additional water storage to maintain the present minimum conditions of streamflow. An annual release of 290 acre-feet will be required from the water supply reservoir to maintain present conditions of streamflow and thereby prevent damages.

Water Quality Control

While it is not anticipated that there will be direct discharges of adequately treated wastes to the Pequonnock River, studies have shown that urban runoff carried into streams can be significantly polluted by accumulated deposits of oil, organic matter, and soil. It is only recently that thoughtful consideration has been given to the possible serious effects of these wastes on stream water quality. Due to the intermittent nature of the pollution, differences in precipitation patterns, character of the runoff area, and conditions in the receiving waters it is not possible to readily extend the

limited available information to the Pequonnock River. It is apparent, however, that there may be a need for flow regulation to assure water quality of a level necessary to maintain present and desired water uses. Any needed water releases for such quality control problems should be more fully evaluated at the design stage of the project.

The downstream resources of the Pequonnock River can be more fully developed by providing flow regulation for water quality control. Table 3 shows the limited available data on water temperature, dissolved oxygen and biochemical oxygen demand of the Pequonnock River.

TABLE 3
PEQUONNOCK RIVER - WATER QUALITY DATA 22/

	<u>Temperature</u> <u>oF</u>	<u>Dissolved</u> <u>Oxygen</u> <u>mg/l</u>	<u>Biochemical</u> <u>Oxygen</u> <u>Demand</u> <u>mg/l</u>
Above Project	68	7.8	3.3
Below Project	75	7.6	3.7
Bunnell's Pond			
Inlet	77	8.8	N. A.
Outlet	77	9.0	5.9

Note: Data shown is for one set of grab samples collected by the Connecticut State Department of Health on September 9, 1964.

The Connecticut Board of Fisheries and Game estimates that a 1.9 MGD release from the project site would be adequate to support a permanent trout stream habitat. A preliminary investigation by the U. S. Fish and Wildlife Service also indicates that additional

flow will increase the fisheries resources of the Pequonnock River. Additional fishing opportunities, especially trout fishing, would add considerably to the recreational values of the Pequonnock River.

A reduction in summer temperatures in the stream can be effected by releases of cold water from the project. It is anticipated that the stream reach from the project to Bunnell's Pond could be converted from a warm-water fishery to a cold-water fishery if such temperature control releases are properly managed.

A cold-water fish, such as trout, must have a minimum of 5 mg/l of dissolved oxygen with a maximum water temperature of 75 degrees Fahrenheit. Slight variations in either parameter for short periods of time should not have adverse effects on a cold-water fish, but it is extremely important to prevent the possibility of major variations in either parameter lest a fish kill result. Therefore, it is necessary that multiple level outlets be installed in the Trumbull dam so that water of the proper water quality may be selected from the reservoir.

Streamflow regulation for water quality control will provide a continuous flow of water in the river below the project site and will thereby tend to stabilize dissolved oxygen levels, and reduce algal growths and bacteria populations. Provision for water quality control will maintain a suitable environment for fish and wildlife promulgation and will insure the necessary quality needed to maintain recreation and natural beauty along the river.

Flow regulation will have direct benefits to local citizens and to interstate travelers. The local population will have increased to 726,000 by 2020 and 950,000 by 2070. The two major

highway routes between New York City and Boston cross the Pequonnock River at Bridgeport, Connecticut, and utilization of the available facilities by travelers can be expected. It is considered that the possible benefits for water quality control would be widespread in scope.

Due to the limited available data on the water quality of the Pequonnock River, it has not been possible up to the present time to determine the amount of water storage required to maintain and enhance the water quality of the Pequonnock River. At the time of design studies, information and data will be available from comprehensive water pollution control studies now under way which will make possible a determination of required water storage for water quality control purposes.

IX VALUE OF WATER STORAGE

The following quotation from Senate Document No. 97 (87th Congress, 2nd session)¹¹ defines the generally accepted method for evaluating the benefits of water resource development projects.

"The amount water users should be willing to pay for such improvement in lieu of foregoing them affords an appropriate measure of this value. In practice, however, the measure of the benefit will be approximated by the cost of achieving the same results by the most likely alternative means that would be utilized in the absence of the project."

Water Supply Benefits

The alternative cost method has been used in this report to evaluate the minimum benefits to be derived from storage for municipal and industrial water supply.

Two alternatives are available to provide the same municipal and industrial water supply as the multipurpose Trumbull Dam and Reservoir. One alternative would be a single-purpose dam and reservoir of 6,450 acre-feet capacity at the proposed project site, and the other would be construction of pumping facilities and a pipeline to provide water from the Housatonic River. As previously noted, a water supply reservoir on the Pequonnock River without provision for maintaining present conditions of minimum flows would seriously damage downstream recreational uses, whereas pumping from the Housatonic River would not be detrimental to other water uses. The cost of preventing damages to these recreational uses has been used to determine the minimum cost of the potential damages that would be caused by the Trumbull project. In order to prevent

damages, a release of 290 acre-feet annually in addition to the 6,450 acre-feet of water supply storage, would have to be provided to maintain present minimum conditions of streamflow. A cost comparison of the alternatives is shown in the following table:

TABLE 4

COST COMPARISON FOR WATER SUPPLY ALTERNATIVES

	<u>Pumping Sta. & Pipe Line</u>	<u>Single-Purpose Res. 6,450 a.f.</u>	<u>Dual-Purpose Res. 6,740 a.f.</u>
Investment Cost	\$2,429,000	\$2,574,000	\$2,690,000
Annual Cost	87,500	92,700	96,900
Annual Oper. & Maintenance	144,000	21,500	21,500
Taxes	26,500	27,500	28,700
Total Annual Cost	258,000	141,700	147,100
Discount 5 yrs. (1975)	221,000	121,500	126,100

The above comparison readily shows that pumping would be cheaper if it were not for the high annual operation and maintenance charge; therefore, a single-purpose water supply reservoir is the least costly alternative. For the above analysis, it has been assumed that the project would be completed in 1970, and the year of first use would be 1975. An amortization period of 25 years at 4 per cent interest has been used to determine the annual payment stream required to develop the alternative water supply by private interest.

The annual value of the potential damages due to a single-purpose water supply reservoir would be \$4,600; i.e., \$126,100 minus \$121,500.

If damages are prevented by the inclusion of additional storage, the annual value of providing water supply storage in the Trumbull project would be $\$126,100 - \$4,600 = \$121,500$.

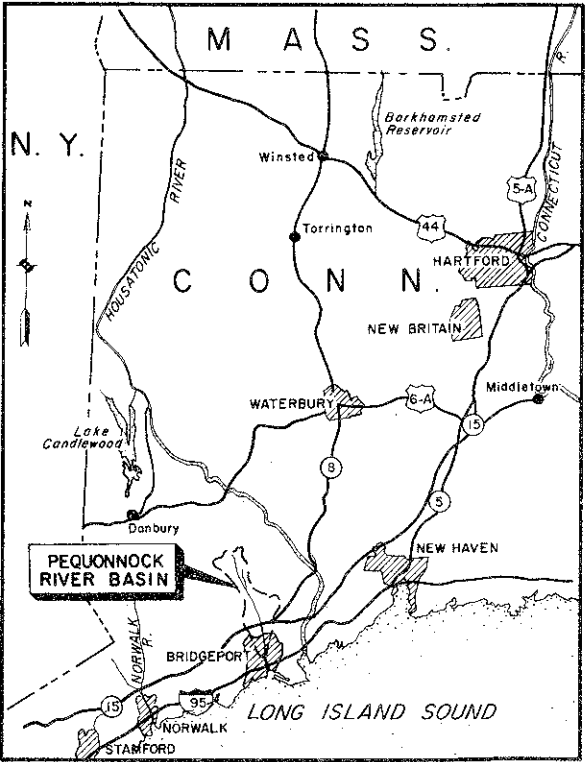
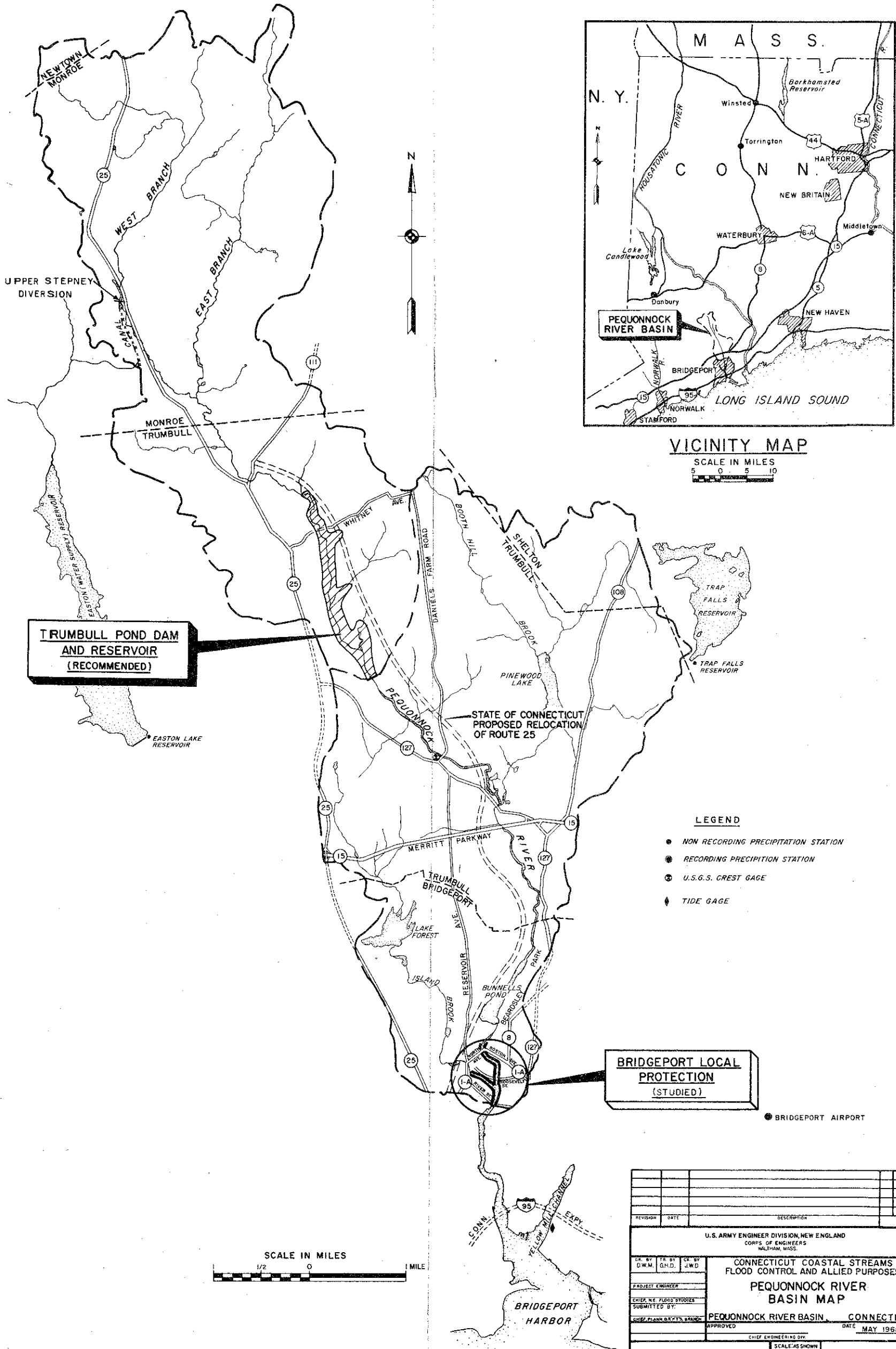
Water Quality Control Benefits

The possible benefits to be gained by maintenance of the water quality of the Pequonnock River through the use of water storage for streamflow regulation are considered to have real value in satisfying human desires; but such benefits generally are not fully measurable in monetary terms, and are often intangible. A portion of such benefits are measurable by the least costly, most likely alternative that would be utilized in the absence of the project. The cost of this alternative affords a measure of the minimum value of the benefits to be derived from water quality control.

The only feasible method of achieving water quality control in the Pequonnock River is to provide water storage for streamflow regulation. The most likely alternative to the multipurpose Trumbull Reservoir would be a single-purpose reservoir at the project site which would provide a continuous flow in the river at all times. The proposed project site is the most economical site available for water storage within the Pequonnock River drainage basin, and a single-purpose reservoir at the project is the only reasonable alternative to a multipurpose project.

Since the required storage for water quality control in the Trumbull Project cannot be determined at this time, no value can be placed on the benefits to be derived from water quality control. However, it is felt that water quality control should be included

as a project purpose to which benefits will be ascribed when quality needs are more adequately defined by comprehensive water pollution control studies now under way.



VICINITY MAP

SCALE IN MILES

5 0 5 10

LEGEND

- NON RECORDING PRECIPITATION STATION
- RECORDING PRECIPITATION STATION
- ⊕ U.S.G.S. CREST GAGE
- ⚓ TIDE GAGE

SCALE IN MILES

1/2 0 1 MILE

REVISION	DATE	DESCRIPTION	BY
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.			
DR. BY D.W.M.	TR. BY G.H.D.	CR. BY J.W.D.	CONNECTICUT COASTAL STREAMS FLOOD CONTROL AND ALLIED PURPOSES PEQUONNOK RIVER BASIN MAP PEQUONNOK RIVER BASIN, CONNECTICUT APPROVED DATE MAY 1965 CHIEF ENGINEERING DIV. SCALE AS SHOWN DRAWING NUMBER
PROJECT ENGINEER			
CHECKED BY PLANS STUDIES			
SUBMITTED BY			
TO ACCOMPANY REPORT DATED: 14 MAY 1965			

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APPENDIXCOMPUTING MUNICIPAL AND INDUSTRIAL WATER SUPPLY BENEFITS

Investment cost of single-purpose water supply reservoir with
6,450 acre-feet of water storage yielding 9.0 MGD is \$2,574,000.

25 yr. payment stream @ 4%: $0.06401 (\$2,574,000) = \$164,800$

Present worth, 25 yrs. @ $3 \frac{1}{8}\%$: $17.17308 (\$164,800) = \$2,829,500$

100 yr. payment stream @ $3 \frac{1}{8}\%$: $0.03276 (\$2,829,500) = \$92,700$

Annual Operation and Maintenance: 21,500

Annual Taxes: 27,500

Total Annual Cost: \$141,700

Construction completed 1970, year of first use 1975; therefore,
discount 5 years.

Annual benefit from 1970: $0.8574 (\$141,700) = \$121,500$

APPENDIX F
RECREATIONAL EVALUATION

APPENDIX F
RECREATIONAL EVALUATION

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APPENDIX F

RECREATIONAL EVALUATION

1. SCOPE

Recreational development at the Trumbull Pond Dam and reservoir project affects two general areas: the area in and around the reservoir and the reach of river with bordering lands downstream of the dam to, and including, Bunnells Pond in Beardsley Park, Bridgeport. This appendix evaluates the planned recreational water resources development and its effect on each area, except for the detailed fish and wildlife recreational analysis which is described in the main report and in Appendix G.

Two projects at the site were evaluated: one for flood control, water supply, water quality control and recreation; and the alternative project for flood control, water quality control, and recreation, excluding the water supply purpose. Connecticut law prohibits water contact sports on water supply reservoirs and discourages picnicking or other intensive land-based activities on land immediately adjacent to a public water supply. The latter project would, therefore, have the far greater recreational benefits.

2. FACTORS AFFECTING RECREATIONAL ACTIVITIES

a. Existing public recreation areas. There is one existing public park-type development within 10 miles of the project having facilities for picnicking and swimming. Within 25 miles, there are 10 developed State parks or forests with 5 picnicking and 9 swimming developments. Two of these are seashore parks. Although many beaches line the seashore in the project vicinity, they are exclusive and allow use only to land owners or renters. The existing areas receive extremely heavy usage, and the addition of facilities at the recommended Trumbull project would be highly welcome, especially if facilities for swimming could be offered.

b. Population. The number of people living within 10 miles of the project has been recorded at over 400,000 by the 1960 U. S. Census and, within 25 miles of the project, 1.2 million. This represents a growth of nearly 25 percent over the 1950 Census figures.

c. Accessibility of the project. The project is readily accessible over an excellent heavily-traveled highway system.

d. Project resources. The site for the recommended Trumbull Reservoir has highly attractive scenic qualities. The project is situated in a deep, narrow valley which is unspoiled by industrial or residential development. The area terrain is unusually rugged for this section of Connecticut. The valley floor, clear of all vegetation other than scrub brush, rises abruptly to well forested, steep, precipitous walls. A gorge 200 feet deep, immediately downstream of the proposed project, highlights the scenery of the valley.

The addition of a permanent water surface behind the project would offer a highly attractive source of water-based recreational pursuits as well as increase the scenic splendor of the area. It would also increase the value of land-based recreational use of project lands.

e. Limits. Although the area is highly attractive and the creation of a water area would increase the recreational opportunities, the precipitous character of the land would limit the extent of practical development. The recommended development area, shown on Plate 2 of the main report, would be limited by the small acreage of land conducive to practical recreational development.

f. Anticipated public use. Intensive public use is expected at the project. One of the most important factors affecting recreational use of the project is the heavy population density of this area in southwestern Connecticut. If water supply is included as a project purpose, the recreational use of the project will be decreased due to the restrictions imposed by that purpose.

The uses of the project lands and water will be highly diversified. With water supply, the project would offer an attraction for such uses as limited picnicking, hiking, unpowered boating and canoeing, nature walks, fishing and small game hunting. Without water supply, the project would have the above uses with the addition of intensive picnicking, camping, swimming and motor boating. A possible recreational development for the project without water supply is shown on Plate H-2 of Appendix H.

The project with water supply is expected to attract an average annual visitation of 20,000 people to view the dam and appurtenant structures. Other uses of the reservoir for leisure time activities of hiking,

limited picnicking, nature walks and unpowered boating would add an average annual visitation of 30,000.

If constructed without water supply, the project would receive heavy usage due to the addition of an unrestricted water-based recreational resource. With adequate development of facilities, it is anticipated that this alternative project would attract an average annual visitation of 230,000 to swim, picnic and camp in addition to the average annual visitation of 20,000 to view the dam and appurtenant structures and 30,000 for leisure time activity mentioned in the previous paragraph.

3. DEVELOPMENT PLAN

a. General. The proposed location of public use areas chosen for development are shown on Plates 2 of the main report and H-2 of Appendix H. These areas are the most adaptable for economical and practical construction of facilities. The layouts shown are schematic and would be altered as necessary during design stages.

b. Land requirements. Land acquisition under existing authorized procedures, accomplished as necessary for other project purposes, will be adequate for recreational development of the project with water supply. To realize the full recreational potential of the project without water supply, it would be necessary to acquire the land above the guide taking line between the project and the proposed State Route 25 relocation. However, if the proposed road relocation is constructed before construction of the Trumbull Reservoir, this land would automatically be acquired due to severance through elimination of access to it.

c. Extent of development. To determine the extent of development necessary to meet demands, an analysis was made of population and trends within a forty-mile radius of the project; the potential inherent in the large tourist and summer resident influx; lack of public park areas in the vicinity; increasing use of New England Division reservoirs; and the physical limitations of the project lands. Design loads were estimated by use of the following National Park Service formula:

$$D. L. = \frac{1}{14} \frac{(AV \times .80)}{1.5} \times .60$$

Where:

D. L. = Design load

14 = No. of summer Sundays

.80 = % of attendance that will use facilities during a normal 14-week season

.60 = % of weekly visitors on a normal summer Sunday

1.5 = rate of turnover

Use of the formula has been verified by experienced visitation data at New England Division Reservoirs. A basic factor in development of the area is the limit of developable land adjacent to the proposed impoundment.

d. Plan of development. Recreational development of the project with water supply will be minor, limited to a small picnic area at the dam and a boat-launching area providing access to the water area. The development plan is shown on Plate 2 of the main report. Interpretive facilities will be placed in the vicinity of the dam and signs will be located throughout the reservoir area to inform the using public of the location of facilities and restrictive uses of the water supply pool.

If the project is constructed without water supply, intensive-use facilities would be developed to meet the anticipated heavy demands. A proposed development plan and location of facilities is shown on Plate H-2 of Appendix H. The northeast shore of the permanent pool was chosen for a major park-type development as the terrain of the area is the best suited for economical development of such facilities. The development would have two separate areas, one for overnight camping and the other for day use. The area would be developed to its maximum potential initially as it is expected full use of the facilities would occur within 5 years of project completion. An access area and boat landing would be developed at the northern end of the permanent pool, and facilities would be provided to accommodate visitors at the dam. Adequate interpretive and directional signs would be placed throughout the project area.

4. ECONOMIC EVALUATION

a. Cost. The recreational development cost of the project with water supply is estimated at \$163,000 and without water supply at \$792,000. These costs include construction costs, contingencies, engineering and design, and supervision and administration. A list of facilities and estimated costs for the alternative projects are shown on Tables F-1 and F-2.

b. Benefits. Average annual recreational benefits, exclusive of fish and wildlife benefits, are estimated as follows:

PROJECT WITH WATER SUPPLY

<u>Type of Use</u>	<u>Visitor-Days</u>	<u>Unit Value</u>	<u>Average Annual Benefit</u>
Visitors to Damsite	20,000	N/A	-
Leisurely Use - Reservoir Area	30,000	0.50	\$15,000
Totals	50,000		\$15,000

PROJECT WITHOUT WATER SUPPLY

Visitors to Damsite	20,000	N/A	-
Leisurely Use - Reservoir Area	30,000	0.50	15,000
Day Use	180,000	0.75	135,000
Overnight Camping	50,000	1.00	50,000
Totals	280,000		\$200,000

c. Intangible benefits. Downstream of the project to Bunnells Pond at Beardsley Park, the Pequonnock River flows through an area of natural habitat for fish and wildlife indigenous to the region. This reach of river with bordering land, much of which is leased by the Connecticut Board of Fisheries and Game, has outstanding recreational features and is aesthetically delightful. In its report on the project (included in Appendix E), the U. S. Department of Health, Education, and Welfare ascribes substantial intangible benefits to the low flow augmentation to be made available for this area downstream of the dam. The continuous flows, which augmentation assures, will lower water temperature, thus reducing amounts of bacteria and algae and enhancing and making more healthful the swimming in Bunnells Pond. The natural beauty of the area will also be enhanced in ways which transcend, and cannot be reduced to, monetary values.

TABLE F-1

TRUMBULL POND DAM & RESERVOIR
RECREATION DEVELOPMENT WITH WATER SUPPLY

<u>Description</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
Site preparation	12	Ac.	\$600.	\$ 7,200
Picnic tables	60	ea.	100.	6,000
Fireplaces	30	ea.	75.	2,250
Trash cans	60	ea.	10.	600
Picnic shelter	1	ea.	L.S.	4,000
Rest rooms	1	ea.	L.S.	12,000
Paths and trails	0.5	mi.	3,000	1,500
Contingencies				6,450
				<u>\$ 40,000</u>
Engineering and design				6,000
Supervision and administration				<u>4,000</u>
Total				\$ 50,000

TABLE F-2

TRUMBULL POND DAM & RESERVOIR
RECREATION DEVELOPMENT WITHOUT WATER SUPPLY

<u>Description</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
Roads and Parking Areas . .		Job	\$L.S.	\$ 141,000
Beach Area . .		Job	L.S.	88,000
Buildings				
Reception and change building	1	ea.	24,000	24,000
Maintenance bldg.	1	ea.	10,000	10,000
Toilets (water-borne)	6	ea.	11,500	69,000
Picnic Facilities				
Tables	465	ea.	100	46,500
Fireplaces	305	ea.	75	22,875
Trash cans	465	ea.	10	4,650
Shelter	1	ea.	4,000	4,000
Camp Sites				
Clearing sites	140	ea.	200	28,000
Group Camp Site				
Site work . .		Job	L.S.	400
Lean-tos	4	ea.	1,500	6,000
Fireplace	1	ea.	1,000	1,000
Water Supply . .		Job	L.S.	18,000
Sewerage System . .		Job	L.S.	18,000
Selective Clearing	53	Ac.	300	15,900
Boat Launching Ramp	1	ea.	1,500	1,500
Signs, Trails, Land-scaping . .		Job	L.S.	25,000
Contingencies				106,175
Subtotal				\$ 630,000
Engineering & Design				100,000
Supervision & Administration				70,000
Total				\$ 800,000

APPENDIX G

REPORT OF THE
BUREAU OF SPORT FISHERIES AND WILDLIFE
FISH AND WILDLIFE SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
59 TEMPLE PLACE
BOSTON, MASSACHUSETTS 02111

November 23, 1964

Division Engineer
U. S. Army Engineer Division, New England
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This letter is our conservation and development report on the fish and wildlife resources related to the Trumbull Pond Dam and Reservoir project, located on the Poquonock River, Fairfield County, Connecticut, being planned under the authority of the September 14, 1955 Resolution of the U. S. Senate Public Works Committee. This report was prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-666 incl.), in cooperation with the Connecticut State Board of Fisheries and Game. That agency concurred in the report as indicated by letter dated November 16, 1964.

We understand that the multi-purpose dam will be located at the site of the former Trumbull Pond dam and about four miles upstream from Beardsley Park Pond (41 acres) in Bridgeport. It will be designed for flood control, domestic water supply, and low-flow augmentation. The former Trumbull Pond dam was washed out in 1950. Streambed elevation at the multi-purpose dam site is at 156 feet mean sea level. The top of the dam will be at elevation 285 and the spillway crest at elevation 270. A twin-chambered tower housing the several intakes at different levels will permit withdrawals at optimum depth. Intakes are being planned for elevations 231, 216, 201, 186, and 156 (bottom). An ungated outlet at elevation 244 is being planned for flood control.

We understand that the following pools are being considered:

Pools	Top elev. m.s.l.	Storage ac./ft/	Maximum depth (ft.)	Surface acres
Dead storage pool	184	600	28	50
Water supply pool	237	5,850	81	178
Low-flow augmentation pool	244	1,350	88	198
Flood control pool	270	5,980	114	268

The domestic water supply pool will be cost-shared by the Bridgeport Hydraulic Company (a private water company servicing nine cities and towns in the Bridgeport area). This reservoir will inundate about two miles of the river when filled to elevation 244. Fishing and boating will be allowed. The company owns most of the land within the project area as well as the riparian rights to the Poquonock River from tidewater to the headwaters.

The low flow augmentation pool will provide a minimum downstream flow of 3 cfs throughout the year. Fluctuations in reservoir levels are not expected to be great. Based on available data it is anticipated that the water-supply storage pool would be exhausted less than once in 50 years.

Approximately 525 acres of land including all land east of the reservoir to the right of way for the proposed Route 25 relocation will be taken in fee title. We understand that a boat-launching ramp and two parking areas will be constructed as a project feature to provide space for 60 to 80 cars and boat trailers. The Corps of Engineers will operate and maintain the fisherman parking areas and boat-launching ramp.

The project lies in a steep-sided, wooded valley. The area fringing the valley is heavily developed, mostly residential with new houses encroaching towards the valley. The project is located about 5 miles north of the City of Bridgeport which has a population of approximately 160,000. A population of approximately 1,300,000 lies within a 35-mile radius of the project. This is about 50% of the State's population and includes almost all of Fairfield and New Haven Counties.

Brook and brown trout are the most important fish species in the Poquonock River. Fishing is maintained by put-and-take stocking by the Connecticut State Board of Fisheries and Game. In 1963

about nine miles of the river were stocked with approximately 5,000 brook and brown trout. This is the major trout stream in the area and is fished heavily due to the lack of such streams in this area.

We understand that if the Federal project is not constructed, the Bridgeport Hydraulic Company will construct a single-purpose water-supply reservoir at the same site. It is expected that the full reservoir will have a surface area about equal to the full water-supply pool of the Federal project. The mileage of stream inundated by this reservoir and the frequency of drawdowns is not expected to be significantly different from that of the Federal reservoir. Although the private impoundment will provide a cold-water fishery habitat, and the company is expected to allow fishing on the reservoir as it does now at its other reservoirs, it probably will not encourage fishing to the extent of providing parking and boat launching facilities. All fishing, therefore, will be confined to shore and this will be limited because of inadequate access. The western shoreline of the reservoir will be steep-sided and provide limited access. The proposed relocation of State Route 25 as a limited access highway will make the eastern shore inaccessible except by foot from the dam or from the upper end of the pool. The utilization of the reservoir fishery could be further affected adversely as a result of private riparian rights and there will be no assurance that downstream releases would not be eliminated during dry periods. For the above reasons the State Board of Fisheries and Game would not stock the reservoir with fish.

It is estimated that during the period of analysis, the fishery in the privately constructed single-purpose reservoir will produce an average of 1,700 fisherman-days annually. The four miles of stream fishery between Beardsley Park Pond and the dam site will furnish an average of 2,800 fisherman-days annually. Beardsley Park Pond (Bunnells Pond), used by swimmers and fishermen, will provide an average of 1,400 fisherman-days annually. The total fishery over the period of analysis will average 5,900 fisherman-days, having a net recreational value of \$20,000.

The multi-purpose reservoir will provide a cold-water lake fishery, the only such fishery within a 20-mile radius. The State Board of Fisheries and Game will stock the reservoir with catchable trout since free public access will be provided. It is estimated that the average annual fishing pressure over the next 100 years will be about 42,000 man-days. In order to accommodate this level of fishing pressure it will be necessary to increase

the fisherman parking and launching facilities as the demand requires. It is estimated that parking areas with a total of 160 spaces for cars with boat trailers will be needed ultimately. This is in addition to parking space needed for general recreation including recreational boating.

The river segment from Beardsley Park Pond upstream to the dam site will be improved for fish life by the discharge of minimum flows of 3 cfs from the lower levels of the reservoir. Cooler water favored by trout would be maintained for longer periods than under existing conditions. This would increase the period of fishing, thus increasing fisherman utilization. Over the period of analysis, an annual fishing pressure of 8,400 man-days is anticipated in the Poquonock River between the Beardsley Park Pond and the project dam.

The low-elevation minimum discharge of 3 cfs flow is expected to change the fishery habitat of Beardsley Park Pond from a warm-water habitat to a marginal cold-water habitat. The State Board of Fisheries and Game will stock the pond with trout since free public access is already provided. A cold-water fishery in Beardsley Park Pond will support an average annual fishing pressure of about 9,800 fisherman-days.

The fishery associated with the multi-purpose Federal project will support an average of 60,200 fisherman-days annually, having a net recreational value of \$230,000. This will result in a fishery benefit of 54,300 fisherman-days annually or a net recreational value of about \$210,000. The breakdown of dollar benefits accruing to each segment are \$161,000 to the reservoir fishery, \$22,000 to the four miles of downstream fishery, and \$27,000 to the Beardsley Park Pond. The levels from which reservoir releases are made should be coordinated with the State Board of Fisheries and Game to obtain maximum fishery utilization of the river downstream from the dam and at Beardsley Park Pond.

In the project area the pheasant is the most important game species and receives heavy hunting pressure. The hunting is maintained by put-and-take stocking by the State Board of Fisheries and Game at an annual rate of about 200 birds. Opening day counts of hunters ranged from 19 to 58. Twelve-hundred hunter-days are conservatively estimated under today's conditions. The principal pheasant habitat is in the portion of the valley that will be inundated by either the private single-purpose reservoir or the multi-purpose reservoir.

The pheasant-hunting opportunities will be totally lost either with or without the Federal project; consequently, no significant wildlife loss will result under with-the-Federal project conditions.

The State Board of Fisheries and Game will undertake all necessary management practices including stocking to obtain maximum fishing benefits if the recommendations listed below are incorporated in the final project plans.

We recommend--

1. That the reservoir discharge be released at such elevations as are recommended by the Connecticut State Board of Fisheries and Game.
2. That additional parking and boat launching facilities for lake fishermen be provided as the demand requires.
3. That additional detailed studies of fish and wildlife resources be conducted, as necessary, after the project is authorized, in accordance with Section 2 of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended, 16 U.S.C. 661-666 inc.), and that such reasonable modifications be made in the authorized project facilities as may be agreed upon by the Director of the Connecticut State Board of Fisheries and Game, the Director of the Bureau of Sport Fisheries and Wildlife, and the Chief of Engineers, for the conservation, improvement, and development of these resources.

Sincerely yours,

A handwritten signature in cursive script, reading "Fred L. Jacobson".

Fred L. Jacobson
Acting Regional Director



STATE OF CONNECTICUT

BOARD OF FISHERIES AND GAME

STATE OFFICE BUILDING • HARTFORD 15, CONNECTICUT

November 16, 1964³

Mr. Earl T. Walker, Acting Regional Supervisor
U. S. Dept. of the Interior
Fish and Wildlife Service
Branch of River Basin Studies
59 Temple Place
Boston, Mass.

Dear Mr. Walker:

This is in reply to your letter of November 5, 1964 and is in regard to the review draft of your conservation and development report on the fish and wildlife resources related to the Trumbull Pond Dam and Reservoir project.

Essentially, we are in complete accord with all details outlined in your report and would commend those people concerned with the provision for recreation being included in this project. The area in which the proposed reservoir is to be constructed is one which is lacking in cold water fisheries recreation opportunities. This type of facility is urgently needed in this densely populated portion of our State.

Our only additional recommendation would be that the 60 to 80 car parking area be considerably enlarged. Since your report estimates some 42,000 man-days of fishing annually, we feel that the parking of a maximum of 80 cars would be far from adequate. We would recommend at least double this capacity with a provision for additional area if the need becomes apparent.

Again we would like to endorse all fisheries recreation provisions contained in your report.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "Theodore B. Sampton".

Theodore B. Sampton
Director

TBB/dg

APPENDIX H
OTHER PROJECTS STUDIED

APPENDIX H
OTHER PROJECTS STUDIED

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TABLES

TRUMBULL POND DAM AND RESERVOIR
WITHOUT WATER SUPPLY

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APPENDIX H

OTHER PROJECTS STUDIED

1. INTRODUCTION

Measures for local flood protection at damage centers in the Pequonnock River basin were considered, including protection by dikes and flood walls with and without channel improvement. Two such plans were studied in some detail but found to be not economically justified. Each of these plans would protect portions of Bridgeport lying along the Pequonnock River downstream of Bunnells Pond dam. One would also provide protection along Island Brook, the chief tributary to the Pequonnock River. The plans are described in the following paragraphs and shown on Plate H-1. Consideration was also given to a multiple-purpose project without water supply at the site of the recommended project.

2. FULL LOCAL PROTECTION

A system of dikes and flood walls combined with channel improvement could be constructed to provide protection for an area of Bridgeport along a one-mile reach of the Pequonnock River downstream of Bunnells Pond dam and along the Island Brook tributary. Downstream of Bunnells Pond dam, dikes extending about 700 and 800 feet respectively on the river sides of Sylvan and Glenwood Avenues would tie into the Boston Avenue bridge abutments and form a "V" shaped alignment to funnel flood waters under the bridge. Flood walls, extending about 625 feet along each bank, would continue the protection downstream from the bridge abutments to an existing box conduit 600 feet long which passes under the buildings in a shopping center. From the lower end of the conduit, the protective work would continue to the River Street bridge, 2,250 feet downstream with about 1,000 feet of short dike sections and retaining walls on the east bank and dikes all along the west bank. The west bank dikes would continue up both sides of the tributary Island Brook, which enters the Pequonnock River about 1,000 feet upstream of the River Street bridge.

As part of its proposed relocation of Route 25 and Capitol Avenue in Bridgeport, the State of Connecticut plans to fill in Seeley Pond on Island Brook. In the highway project, the brook would be relocated in a conduit rejoining the original stream bed at a point about 1,800 feet from the mouth of the brook. The Corps project

would extend that conduit about 400 feet farther and continue the protection 1,400 feet to the Pequonnock River by dikes on both banks of the brook continuous with those on the west bank of the river. Short sections of flood wall are substituted for dikes where necessary for clearance.

The channel would be improved and straightened on the Pequonnock River downstream of the existing box culvert and along about 1,000 feet of Island Brook. Two new bridges would be required: one for Boston Avenue, the other for Roosevelt Street. Land taking would amount to about 19 acres. The first cost of this protection is \$2,890,000 with annual charges of \$108,200. Annual benefits, all flood control, are \$80,000 when considered alone, and \$28,600 when taken after the Trumbull Pond dam, resulting in benefit-cost ratios of 0.74 and 0.26, respectively.

3. LIMITED LOCAL PROTECTION

A project providing protection for a smaller area was also considered. In this plan, the protective works would be the same as in the full plan for the Pequonnock River between Bunnells Pond and the inlet to the existing box conduit. Downstream of the conduit, the channel of the river would be improved as far as the River Street bridge. There would be no dikes along the river and no protective work on Island Brook. The Boston Avenue and Roosevelt Street bridges would be rebuilt as in the full plan. First costs are estimated at \$1,370,000 with annual charges of \$46,500. Annual benefits to the project, acting after the Trumbull Pond reservoir, are \$18,600, resulting in a benefit-cost ratio of 0.40. When considered without the Trumbull Pond project, benefits would be \$49,200, resulting in a benefit-cost ratio of 1.06. The reservoir project acting alone realizes almost this amount of benefits in the considered area (\$44,600) in addition to substantial flood control benefits in other reaches of the river and benefits from other project purposes and is therefore considered preferable.

4. DEGREE OF PROTECTION - LOCAL PROTECTION PROJECTS

The degree of protection feasible for the areas considered is limited by the capacity of the existing box conduit under the shopping center. To enlarge this conduit would be difficult and very costly. The local protection projects were therefore designed on the basis of the capacity of the conduit which is 5,800 c.f.s. This flow is about equivalent to the maximum flood of record natural, and 75 percent of the standard project flood reduced by the recommended Trumbull Pond

reservoir. Thus either of the considered local protection projects would give a reasonable, although not high, degree of protection to the area.

5. TRUMBULL POND DAM AND RESERVOIR (ALTERNATIVE)

a. Introduction. Although basin needs for water supply are expected to become urgent within a few years of the estimated date of project completion, the possibility exists that contractual arrangements might not be consummated for municipal and industrial water supply. Therefore, studies were made of an alternative project which would exclude water supply as a purpose thereby permitting unlimited recreational use. The dam would be of the same height and at the same site as for the recommended project to permit future conversion to water supply storage purposes and to provide optimum depth and size of pool for recreational purposes, including benefits to the fishery resources. The deeper water thus provided would be a requisite for a cold water fishery both in the reservoir and in the stream below the project.

b. Description. The three-purpose project would contain, in addition to 5,980 acre-feet of storage for flood control, 7,500 acre-feet for recreation, and 300 acre-feet for water quality control. The dam and appurtenant structures would be substantially the same as for the recommended four-purpose project described in the main report except that the intake tower for water quality control releases would be single-chambered, housing multiple intake gates to permit withdrawals at optimum temperature and oxygen content for the downstream fishery. A map outlining the reservoir and showing salient features for this three-purpose project is shown on Plate H-2.

c. Recreational development. In addition to the picnic and overlook area and boat launching ramp provided in the recommended project, a beach area, picnic facilities, camp sites, service facilities including water and sewers, a reception and change building and a maintenance building would be located on the east shore of the project as shown on Plate H-2. With unlimited recreation permitted, it is estimated that 260,000 persons would utilize the facilities annually in addition to some 20,000 sightseers.

d. Economic evaluation. A summary of costs of this alternative project is given in Table H-1. A comparison of annual charges and annual benefits for each of the three project purposes is shown in Table H-2. Table H-3 summarizes cost-sharing under various policies.

TABLE H-1

TRUMBULL POND DAM AND RESERVOIR
WITHOUT WATER SUPPLY
FIRST COSTS AND ANNUAL CHARGES
 (1965 Price Level)

FIRST COST

Lands and damages	\$ 935,000
Reservoir	100,000
Dam	2,760,000
Recreation facilities	630,000
Engineering and design	530,000
Supervision and administration	<u>435,000</u>
Total estimated First Cost	\$5,390,000
Interest during construction	168,000
Total Project Investment	<u>\$5,558,000</u>

ANNUAL CHARGES

Interest	\$ 173,700
Amortization	8,400
Operation and maintenance	9,000
Major replacements	<u>24,400</u>
Total Financial Annual Charges	\$ 215,500
Loss of taxes	<u>13,800</u>
Total Economic Annual Charges	\$ 229,300

TABLE H-2

TRUMBULL POND DAM AND RESERVOIR
WITHOUT WATER SUPPLY
PROJECT FORMULATION

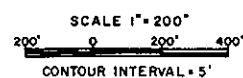
<u>Purpose</u>	<u>First Cost</u>	<u>Annual Charges</u>	<u>Annual Benefits</u>	<u>Benefit: Cost Ratio</u>
Flood control	\$1,687,000	\$ 65,400	\$100,700	1.5
Recreation	3,295,000	146,000	361,000(1)	2.5
Water quality	<u>408,000</u>	<u>17,900</u>	<u>49,000(2)</u>	<u>2.7</u>
Totals	\$5,390,000	\$229,300	\$510,700	2.2

- (1) Benefits to general recreation and reservoir fishing.
 (2) Benefits to downstream fishing only; additional benefits anticipated by Public Health Service for dilution of pollution due to urban runoff.

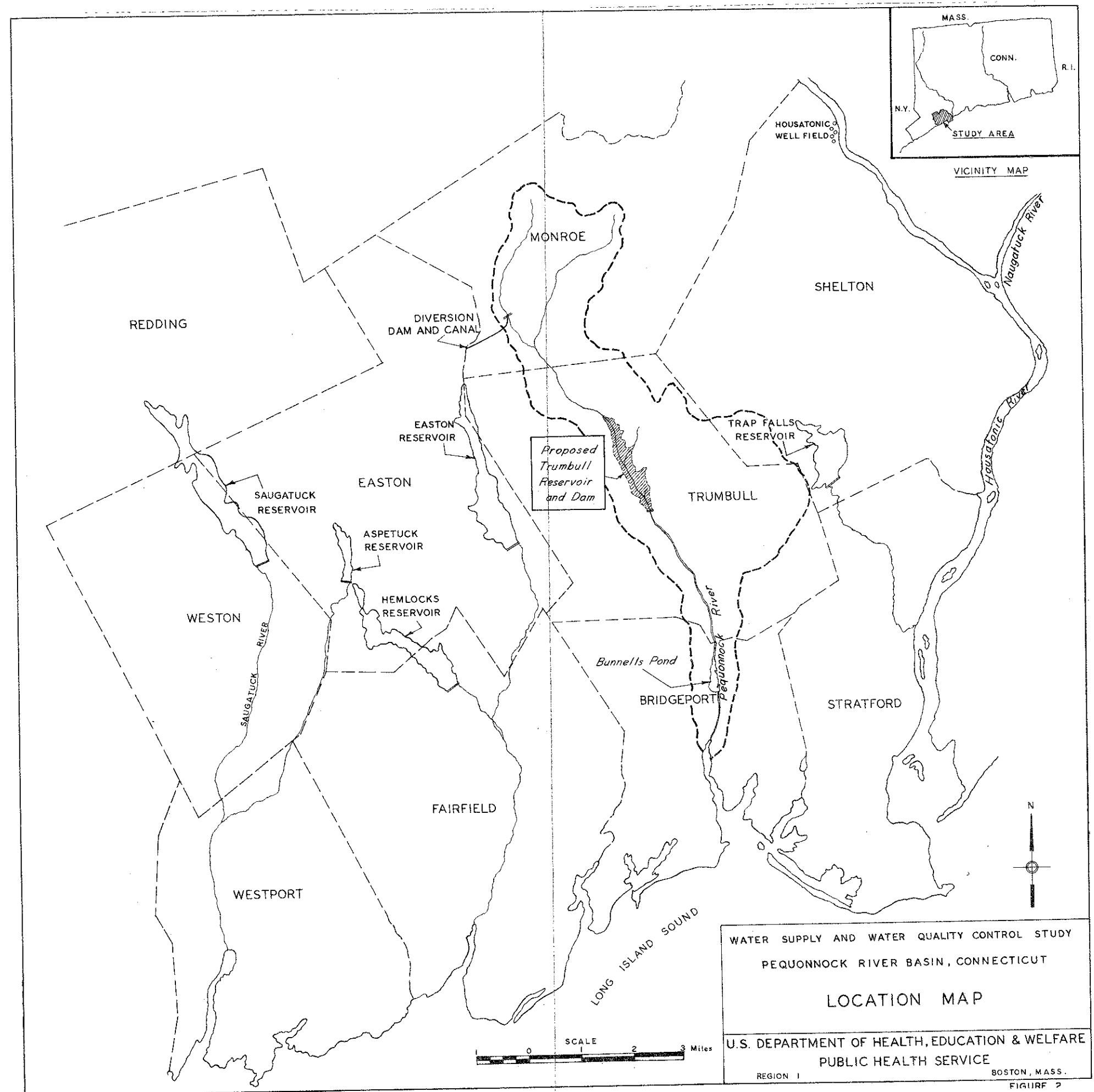
TABLE H-3

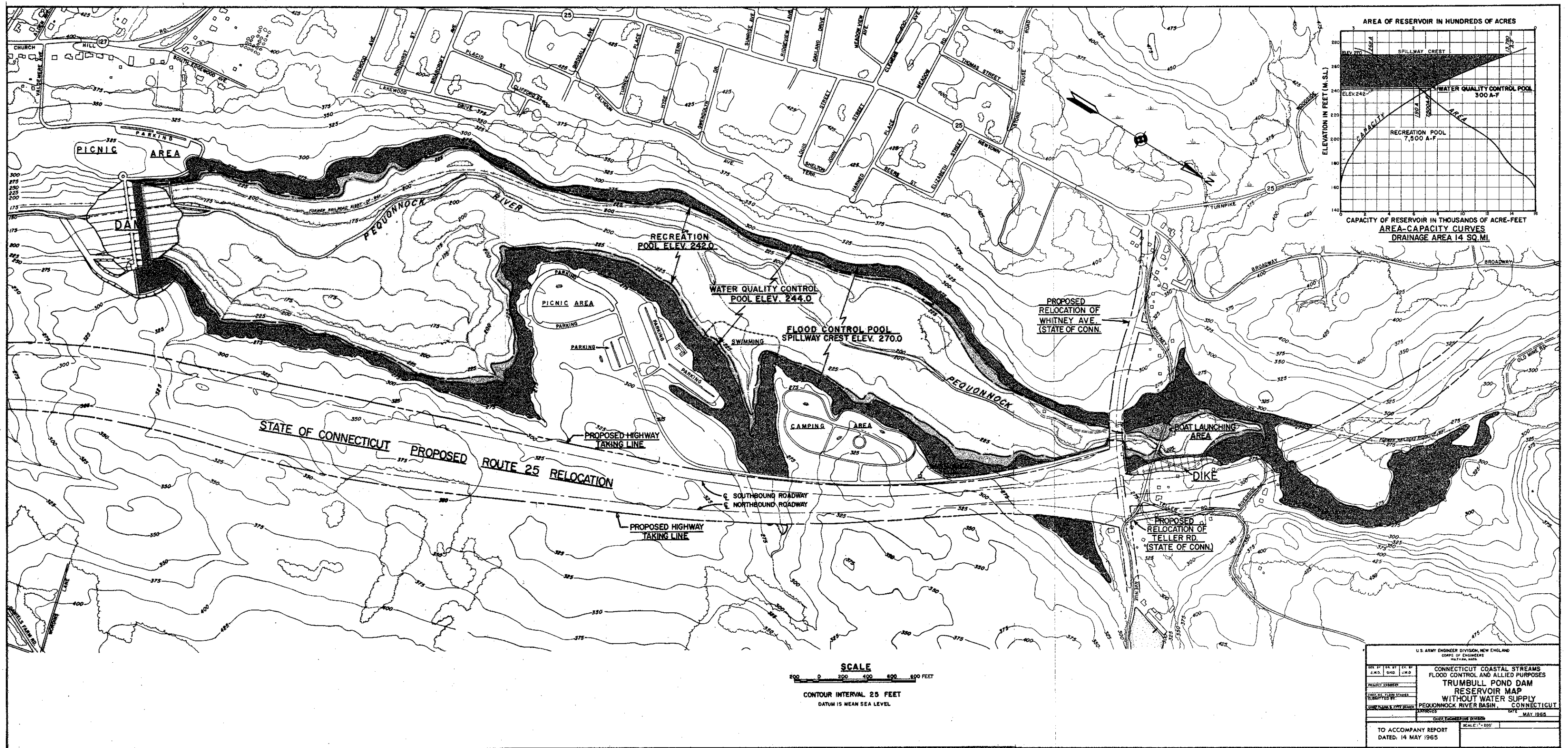
TRUMBULL POND DAM & RESERVOIR
(WITHOUT WATER SUPPLY)
COST-SHARING FOR RECREATION
(Including Fish and Wildlife Enhancement)
(1965 Price Level)

1.	<u>Basic Data (From cost allocation study)</u>	
a.	Total costs	\$5,390,000
b.	Total specific costs	891,000
c.	Total joint-use costs	4,499,000
d.	Costs allocated to recreation	3,295,000
e.	Separable costs, recreation	2,925,000
f.	Joint costs, recreation	370,000
g.	Specific costs, recreation	800,000
h.	Other costs, recreation	2,125,000
2.	<u>Cost-Sharing under H. R. 5269</u>	
a.	<u>Federal</u>	
	(1) Joint costs (lf)	370,000
	(2) $\frac{1}{2}$ Separable costs ($\frac{1}{2} \times 1e$)	1,462,500
	(3) Federal cost	1,832,500
b.	<u>Non-Federal</u>	
	(1) $\frac{1}{2}$ Separable costs ($\frac{1}{2} \times 1e$)	1,462,500
3.	<u>Cost-Sharing under H. R. 9032</u>	
a.	<u>Federal</u>	
	(1) Specific costs (lg)	800,000
	(2) Other costs (lh)	2,125,000
	(3) Limit on other costs (25% x 1c)	1,124,750
	(4) Joint costs (lf)	370,000
	(5) Limit on joint costs (25% x 1c)	1,124,750
	(6) Federal cost [(1) + smaller of (2) or (3) + smaller of (4) or (5)]	2,294,750
b.	<u>Non-Federal</u>	
	(1) Excess of other costs [a(2) - a(3)]	1,000,250
	(2) Excess of joint costs [a(4) - a(5)]	None
	(3) Total non-Federal cost [b(1)+b(2)]	1,000,250
4.	<u>Cost-Sharing under Previous Corps Policy</u>	
a.	<u>Federal</u>	
	(1) Specific costs (lg)	800,000
	(2) Joint costs, recreation (lf)	370,000
	(3) Limit on joint costs (25% x 1a)	1,347,500
	(4) Other costs (lh)	2,125,000
	(5) Federal cost [(1) + smaller of (2) or (3) + (4)]	3,295,000
b.	<u>Non-Federal</u>	
	(1) Excess of joint costs [a(2)-a(3)]	None



U.S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.		
DES. BY JWD	DR. BY GHD	CL. BY JWD
CONNECTICUT COASTAL STREAMS FLOOD CONTROL AND ALLIED PURPOSES LOCAL PROTECTION BRIDGEPORT, CONNECTICUT		
PROJECT ENGINEER CHIEF, N.E. FLOOD STUDIES SUBMITTED BY:		
CHIEF, PLANNING & RPT'S BRANCH PEQUONNOCK RIVER BASIN, CONNECTICUT APPROVED _____ DATE MAY 1965 CHIEF, ENGINEERING DIVISION		
TO ACCOMPANY REPORT DATED: 14 MAY 1965		SCALE AS SHOWN DRAWING NUMBER





APPENDIX I

LETTERS OF COMMENT AND CONCURRENCE

APPENDIX I

LETTERS OF COMMENT AND CONCURRENCE

INDEX

<u>Exhibit No.</u>	<u>Agency</u>	<u>Letter Dated</u>
I-1	Federal Power Commission	26 April 1965
I-2	U.S. Bureau of Public Roads	16 Nov. 1964
I-3	Connecticut Water Resources Commission	5 Feb. 1965
I-4	Connecticut State Highway Department	24 Nov. 1964
I-5	New England Division, Corps of Engineers	15 Dec. 1964
I-6	Town of Trumbull	4 Jan. 1965
I-7	Trumbull Conservation Comm.	31 Dec. 1964
I-8	Bridgeport Hydraulic Company	19 Nov. 1964

FEDERAL POWER COMMISSION

REGIONAL OFFICE
346 Broadway
New York, New York 10013

April 26, 1965

Division Engineer
U. S. Army Engineer Division, New England
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

File NEDED

Subject: Trumbull Pond Dam and Reservoir,
Trumbull, Connecticut

Dear Sir:

Pursuant to request contained in your letter of April 22, 1965, there are set forth herein our views with respect to possible power development at the proposed Trumbull Pond dam and reservoir project on the Pequonnock River in Trumbull, Connecticut.

The dam would control the runoff from 14.0 square miles of drainage area and provide storage for flood control, water supply and low flow augmentation, equal to about 18 inches of runoff. The estimated average flow at the site is 25 cfs with minimum daily flows less than 1 cfs.

Our staff has reviewed the pertinent data furnished with your letter and investigated the possibility of developing power at the site. It was found that the small amount of power that could be developed would not be practicable nor economically feasible. It is concluded, therefore, that development of hydroelectric power in conjunction with the other purposes would not be warranted.

Sincerely yours,


D. J. Wait
Regional Engineer

EXHIBIT I - 1

REGION ONE

CONNECTICUT
MAINE
MASSACHUSETTS
NEW HAMPSHIRE
NEW JERSEY
NEW YORK
RHODE ISLAND
VERMONT
PUERTO RICO

U. S. DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS

990 Wethersfield Avenue
Hartford, Connecticut 06114

November 16, 1964

Brigadier General P. C. Hyzer, Division Engineer
U. S. Army Engineer Division, New England
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear General Hyzer:

Receipt of your - "Notice of Public Hearing on Poquonock River Basin, Bridgeport, Trumbull, and Monroe, Connecticut for Flood Control and Allied Purposes" - is herewith acknowledged. In connection with your proposal, we call to your attention that the Connecticut State Highway Department has made a study for the future relocation of Connecticut State Route 25, from Bridgeport to Newtown, and has held Public Hearings on the finally proposed location in Bridgeport and Trumbull.

This route is part of the Federal-aid Highway System and we have indicated our general approval of the corridor for the highway as proposed by the State. The location in the vicinity to be affected by your proposed dam is along the easterly side of the Poquonock River and we find that there may be some conflict. We are advised by the State Highway Department that you are aware of this condition and that coordination is being undertaken.

Very truly yours,

Leo Grossman
Division Engineer

By:



M. F. Boomer, Division
Planning and Programing Engineer

EXHIBIT I - 2



STATE OF CONNECTICUT

WATER RESOURCES COMMISSION

STATE OFFICE BUILDING • HARTFORD 15, CONNECTICUT

February 5, 1965

Mr. John W. Leslie, Chief
Engineering Division
U. S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham 54, Massachusetts

Re: Trumbull Pond Dam and Reservoir
Poquonock River
Trumbull, Connecticut

Dear Mr. Leslie:

Reference is made to your letter of November 6, 1964 requesting any comments from this Commission concerning the proposed multi-purpose dam and reservoir under the above captioned project.

The general views of this agency were expressed during the public hearing held on this project on December 8, 1964. Briefly, the project as outlined in your letter appears to have considerable potential benefits in the important fields of recreation, flood control and water supply with minimum collateral adverse effects as compared with other projects considered.

The project as proposed appears to the Commission as an important and beneficial one and fits the general plan of good water resource development.

The Commission is pleased to note that no local contributions will be required outside of that required for provisions for water supply; it is assumed that a program will be established for operation of both the recreation and water supply phases; that the State will not be required to provide land, easements and rights-of-way necessary for the construction; and that a favorable benefit-cost ratio will be realized even if the Bridgeport Hydraulic Company should decide not to take advantage of the possible water supply storage.

Very truly yours,

A handwritten signature in cursive script, reading "William S. Wise".

William S. Wise
Director

WSW:dlp

EXHIBIT I - 3



STATE OF CONNECTICUT
STATE HIGHWAY DEPARTMENT
24 WOLCOTT HILL ROAD, WETHERSFIELD
P.O. BOX 2188, HARTFORD 15, CONNECTICUT 06109

November 24, 1964

General P. C. Hyzer
Division Engineer
U.S. Army Engineer Division, New England
Corps of Engineers
424 Trapelo Road
Waltham 54, Massachusetts

Re: NEDED-R
Flood Control, Trumbull, Connecticut

Dear General Hyzer:

This will acknowledge your notice of a Public Hearing to be held on Tuesday, 8 December 1964, at Trumbull, Connecticut, regarding flood control and allied improvements on the Poquonock River in the Town of Trumbull.

The planning profile for a proposed relocation of Connecticut Route 25 in this vicinity, which was forwarded to your office on January 29, 1964, shows a roadway grade below the elevation of the spillway crest of the proposed dam for a distance of 1400 feet at Whitney Avenue near the north end of the proposed reservoir. If a project for the construction of the multiple-purpose dam and reservoir as described in your Public Notice is approved, a modification of the profile for relocated Route 25 will be required.

You may be assured that the Highway Department will continue to cooperate with your office in the development of plans for the relocation of Route 25 as they may be affected by the proposed multiple-purpose dam and reservoir at Trumbull.

Very truly yours,

A handwritten signature in dark ink, appearing to read "Howard S. Ives", written over a horizontal line.

Howard S. Ives
State Highway Commissioner

EXHIBIT I - 4

C O P Y

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND

CORPS OF ENGINEERS

424 TRAPELO ROAD
WALTHAM, MASS. 02154

ADDRESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO.

NEDED-R

15 December 1964

Mr. Clarence F. Heimann, First Selectman
Town of Trumbull
Town Hall
Trumbull, Connecticut

Dear Mr. Heimann:

In reply to your question raised at the recent Public Hearing on the Trumbull Pond project, a preliminary estimate indicates that it would cost about \$350,000 to increase the top width of the dam and construct a bridge over the spillway to provide for a 2-lane road across the project. This cost would have to be borne by non-Federal interests unless the State Highway Department and the Federal Bureau of Public Roads determine that such modification is desirable and needed as a link in the State or Federal-aid highway systems, in accordance with the provisions of Public Law 562, 76th Congress, approved 29 July 1946.

It is not necessary for you to make a decision on this matter at this time, since such a modification could be incorporated in the project, after authorization, at the time detailed design is initiated.

Your assistance in the success of the Hearing and in our development of the Trumbull Pond project is greatly appreciated.

Sincerely yours,

JOHN WM. LESLIE
Chief, Engineering Division

C O P Y

EXHIBIT I - 5

TOWN OF TRUMBULL
CONNECTICUT

CLARENCE F. HEIMANN
First Selectman



Town Hall

Telephone
268-1633

January 4, 1965

Mr. John Wm. Leslie
U. S. Army Engineer Div., New England
Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Dear Mr. Leslie:

Your letter dated December 15, 1964 was received and discussed by the Board of Selectmen.

It is our wish to reserve decision in the matter until your engineers approach the design stage.

Thank you for your consideration.

Very truly yours,

A handwritten signature in cursive script, appearing to read "Clarence F. Heimann", is written over a horizontal line.

Clarence F. Heimann,
First Selectman

CFH:ach

CONSERVATION COMMISSION

Town of Trumbull

CONNECTICUT



TOWN HALL
TRUMBULL, CONNECTICUT

December 31, 1964

U.S. Army Corp of Engineers
424 Trapelo Road
Waltham, Massachusetts

Att: Mr. Dill

Gentlemen:


Subsequent to the public hearing held by you in Middlebrooks School on December 8, 1964 relative to your proposal for the Trumbull Flood Control project off Whitney Avenue a report was made to the Conservation Commission.

A discussion was held on the various facts presented. Even though two members of the Commission spoke in favor of this proposal at the public hearing, the Commission felt that they wished to express their full support for the multi-purpose reservoir project.

The Conservation Commission's interest and goal is to protect and conserve all aspects of our natural resources in order to best serve our future generations and hope that your program will become a reality.

Very truly yours,

CONSERVATION COMMISSION
TOWN OF TRUMBULL


Paula A. Elterich,
Chairman

PAE:kg

EXHIBIT I - 7

BRIDGEPORT HYDRAULIC COMPANY

BRIDGEPORT 1, CONNECTICUT

November 19, 1964

FREDERICK B. SILLIMAN
PRESIDENT

Division Engineer
U.S. Army Engineer Division
New England Corps of Engineers
424 Trapelo Road,
Waltham 54, Massachusetts

Attention: Mr. John Wm. Leslie,
Chief, Engineering Division

RE: YOUR FILE NEDED-R

Dear Sirs:

This will acknowledge receipt of your letter dated October 26, 1964, with reference to the multiple-purpose Trumbull Pond project.

Based upon the limited information and preliminary data which has been submitted to this Company, we concur generally in the future water supply plans for the proposed project and consider that the storage allocated for such future water supply appears reasonable.

This Company will probably be interested in the water supply features of the completed project assuming the use of the water for distribution to its customers would not violate any provisions of the charter of the Company or any law of the State of Connecticut or regulation of its Public Utilities Commission.

Any use by this Company of the water supply would be contingent upon the prior execution of agreements and contracts satisfactory to this Company.

Very truly yours,



FRED B. SILLIMAN

F.B.Silliman:mm

EXHIBIT I - 8

ATTACHMENT 1

PEQUONNOCK RIVER BASIN
CONNECTICUT

Information Called for by

Senate Resolution 148, 85th Congress

Adopted 28 January 1958

PEQUONNOCK RIVER BASIN, CONNECTICUT

Information Called for By

Senate Resolution 148, 85th Congress, Adopted 28 January 1958

1. PROJECT DESCRIPTION AND ECONOMIC LIFE

a. Recommended project. The city of Bridgeport and town of Trumbull in Connecticut have experienced severe damages from past flooding on the Pequonnock River. These damages can be reduced by construction and operation of a dam and reservoir on that river in Trumbull. The area of the Pequonnock River basin has a great potential for full water resources development. Therefore, it is proposed to construct a dam and reservoir to provide for project purposes of flood control, water supply, recreation, and water quality control.

The dam, located at the Trumbull Pond site approximately 3.5 miles upstream of the Bridgeport-Trumbull line, would impound a reservoir having a maximum length of about 2.5 miles and storing a total of 13,780 acre-feet, of which 5,980 acre-feet would be for flood control, 5,850 acre-feet for water supply, 1,350 acre-feet for water quality control, and 600 acre-feet for dead or sediment storage. The recreational purposes of the project would be fulfilled by development and use of reservoir land area above spillway crest elevation and by limited use of the water supply pool. More detailed descriptions of the project are given in Section X of the main report and in Appendix D and are portrayed on Plates 2 and 3 of the main report.

b. Alternative projects. An alternative, economically feasible project was considered at this site in view of the possibility - however remote - that the local water supplier might not participate with the Federal Government in the project. A study was made of a three-purpose project for flood control, water quality control, and recreation. This alternative, without water supply provisions, would present greater recreational opportunities than the recommended project, mainly because more extensive water use would be allowed. Since local participation in the water supply provisions of the recommended project seem assured, the alternative project is not recommended.

Two local protection projects were considered but not recommended. Each one was found economically infeasible when considered in conjunction with the recommended reservoir. Although the more favorable local protection plan, when considered alone, would have a benefit-cost ratio greater than unity, it would not provide the basin water resource development to be gained by a reservoir project.

c. Economic life. The estimated project life used in the economic analyses in the report is 100 years.

2. PROJECT COSTS

Project first costs are based on average bid prices for similar work in the same general area adjusted to 1964 price levels. Valuation of property is based on the Market Data Approach and reflects recent sale values in the area. Land costs are based on the estimated fee value. All estimates include allowances for contingencies and costs for engineering and overhead. The investment includes interest during construction computed at 3-1/8 percent for costs financed by Federal and non-Federal interests for one-half the estimated construction period.

Tables I and III in the main report present summaries of costs for the recommended reservoir with details given in Appendix D. The economically feasible alternative reservoir project is discussed in Appendix H.

3. PROJECT BENEFITS AND BENEFIT-COST RATIOS

Table IV in the main report gives a summary of benefits and benefit-cost ratios for the recommended project and for each of the project purposes included in the recommended project. To determine the average annual water supply benefits which would accrue to the recommended reservoir, the annual charges for the alternative single-purpose water supply reservoir were discounted to reflect the estimated period before water supply would first be used after completion of the project.

Although the alternative project without water supply has a greater excess of benefits over costs than the recommended project, the latter was selected for recommendation in view of the imminent need for additional water supply in the area.

4. INTANGIBLE PROJECT EFFECTS

a. Flood control. Operation of the Trumbull Pond Reservoir would minimize the downstream flood threat in a recurrence of the maximum flood of record in the basin. Elimination of the menace to life posed by raging flood waters and of the danger of disease, ever present in the aftermath of a serious flood, would improve the social and economic climate of now flood-prone areas of Bridgeport and Trumbull.

b. Water resources development.

(1) Water supply. The Trumbull Pond reservoir, utilizing the last feasible site for a source of significant surface water supply in the area, would alleviate anticipated future needs for domestic and industrial supply, estimated to become a reality by 1975. The effect of an assurance of continuing water supply with minimal water rates would be a positive benefit for basin populations, although not measurable in monetary terms.

(2) Low flow augmentation. The existing fishing and other recreational activities along the Pequonnock River downstream of the project are dependent on the maintenance of present, normal flow. This flow is in jeopardy since the area water supply company possesses legal control over the Pequonnock River flow and might have to effect a shut-off in a time of prolonged drought. Shutting off flows would lower water levels and allow a rise in water temperature and build-up of bacteria and algae with resulting impairment of the stream fishery and the conditions for swimming at Bunnells Pond, and nullification of the aesthetic values of the area.

The provision of storage to augment low flows would give intangible benefits to the protection of public health and enhancement of aesthetic values presently available to the public along the water-course downstream to, and inclusive of, Bunnells Pond.

5. PHYSICAL FEASIBILITY AND COST OF PROVIDING FOR FUTURE NEEDS

The central portion of an area of the city of Bridgeport that would be protected by the Trumbull Pond Reservoir is expected to change to higher land use by 1975, within five years after the

probable completion date of the project. Land in the flood plain in Trumbull will probably be completely built over by 1970. In planning for flood protection of this area by the Trumbull Pond Reservoir, future as well as present flood control needs are considered.

Construction of a multiple-purpose dam and reservoir at the site would help satisfy needs for water supply, water quality control and recreation in addition to flood control. Each need would be met more economically by this combination of purposes in one dam and reservoir than it would be by construction of a single-purpose reservoir for that purpose. The water supply storage yielding 9 million gallons per day, provided by the project, would meet a shortage expected to begin to materialize by 1975.

Immediate needs for flood control, water quality control, and recreation would be met by the construction of the Trumbull Pond Dam and Reservoir. The need for water supply in the area will materialize soon after the estimated completion date of the project. Since local cooperation is expected to be forthcoming, provisions for water supply to meet the future need is also included.

6. ALLOCATION OF COSTS

Table 1 summarizes the results of allocating project costs using three methods of allocation: the Separable Costs-Remaining Benefits method; the Priority of Use Method; and the Incremental Cost Method. The table also illustrates the effect of using project lives of 100 years and 50 years.

7. EXTENT OF INTEREST IN THE PROJECT

The Water Resources Commission of the State of Connecticut considers that the Trumbull Pond Dam is needed for the flood protection of damage centers in Trumbull and Bridgeport. The Selectmen of the town of Trumbull have expressed themselves in favor of the project.

The Bridgeport Hydraulic Company, the area water supplier, concurs generally in the water supply plans for the project and considers that the 5,850 acre-feet of storage allocated for water supply appears to be a reasonable amount.

The U. S. Department of Health, Education and Welfare, concurring in the project, states that the 9 m.g.d. of water supply storage to be provided by the project, together with existing supplies and supply from development of other presently available sources, will give the local water supplier a total safe yield of 109.5 m.g.d. This amount will be needed in the area before the year 2000. The Department further recommended that storage be provided for additional flows of 1.9 m.g.d. (3 c.f.s.) to prevent damages from low flow and to improve the area downstream, especially to enhance recreational and aesthetic values.

The Fish and Wildlife Service of the U. S. Department of the Interior states that a valuable trout fishery could be maintained downstream of the project provided the recommended provision for low flow augmentation is included. The recommendations of the Fish and Wildlife Service are: (1) that the reservoir discharge be released at such elevations as are recommended by the Connecticut State Board of Fisheries and Game, and (2) that additional detailed studies of fish and wildlife resources be conducted as necessary after the project is authorized in accordance with Section 2 of the Fish and Wildlife Coordination Act, and that such reasonable modifications be made in the authorized project facilities as may be agreed on by the Director of the Connecticut State Board of Fisheries and Game, the Director of the U. S. Bureau of Sport Fisheries and Wildlife, and the Chief of Engineers, for the conservation, improvement, and development of these resources.

The Connecticut State Highway Department has no objection to construction of the Trumbull Pond Dam and Reservoir and will cooperate in the development of plans for the relocation of the proposed Route 25 as these plans may be affected by the project.

Local interests are strongly in favor of the proposed improvement as evinced by numerous statements made at the public hearing on the Pequonnock River basin held in Trumbull on 8 December 1964. The local water supply company indicated a willingness to enter into a partnership arrangement in cost sharing the recommended project.

8. REPAYMENT SCHEDULES

Start here

→ Payment for water supply is required of local interests on the basis that they would repay the United States the entire amount of the construction costs, ~~including interest during construction~~ allocated

to water supply within the life of the project but in no event to exceed fifty years after the project is first used for the storage of water for water supply purposes, except that (1) no payment need be made with respect to storage for future water supply until such supply is first used, and (2) no interest shall be charged on such cost until such supply is first used, but in no case shall the interest-free period exceed ten years.

Payment of the cost allocated to water supply, amounting to ^{24.9}~~49.5~~ percent of the total project investment ~~including interest during construction~~, and currently estimated at ^{474,000}~~\$2,554,000~~, is a requirement of local participation in the recommended ^{Beaver Brook}~~Trumbull Pond~~ Dam and Reservoir project. The water supply storage is not expected to be needed for ^{about 20}~~a few~~ years subsequent to project completion ^{and}~~but~~, under the provisions of the Water Supply Act of 1958, as amended, the maximum allocated cost of storage for future use cannot exceed 30 percent of the total project investment, ~~currently estimated at \$1,547,000 for this project. The excess, or 19.5 percent of the project investment, currently estimated at \$1,007,000, must be contracted for in full at the time of project construction as payment for water supply for immediate use.~~ Local interests would also be required to pay the allocated annual costs of maintenance, operation, and major replacements, currently estimated at ^{1,800}~~\$17,700~~.

Under the provisions of H. R. 5269, 89th Congress, local interests would also have to bear not less than one-half the separable costs of the project allocated to recreation and fish and wildlife enhancement, an amount currently estimated at ^{51,500}~~\$254,000~~, and all the costs of operation, maintenance, and replacement of recreation and fish and wildlife enhancement lands and facilities, an amount currently estimated at ^{6,600}~~\$4,700~~ annually.

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9. EFFECT OF PROJECT ON STATE AND LOCAL GOVERNMENTS

Study of the areas to be protected indicates a trend toward higher utilization in a portion of Bridgeport and further development of all usable land in the Trumbull flood plain. The effect of the project construction would intensify this trend but is not assessable in tangible or monetary terms.

The project would have little adverse effect on State and local governmental services since schools, police and fire protection, utilities, and other public services are already provided in the areas. Construction of a sewage system in Trumbull, at present under preliminary planning, would not be greatly affected by the project.

Most of the land which the project would occupy has been kept undeveloped by the owner, the Bridgeport Hydraulic Company, as part of a water supply watershed program. Loss of the small State and local government revenue from taxes on this land would be offset by an increase in taxable value of now flood-prone properties to be protected.

10. PROPOSED INCREASE IN APPROPRIATIONS

The construction of the recommended project would require a Federal appropriation of \$5,000,000, of which \$2,475,000 is reimbursable under the Water Supply Act of 1958, as amended. This is the only recommendation contemplated for the basin at this time and constitutes a comprehensive plan for development of the basin resources.

TABLE 1

SUMMARY OF COST ALLOCATIONS
TRUMBULL POND DAM
 (All Amounts in Thousand Dollars).

	100-YEAR PROJECT LIFE					50-YEAR PROJECT LIFE				
	<u>Flood Control</u>	<u>Water Supply</u>	<u>Recreation</u>	<u>Water Quality Control</u>	<u>Totals</u>	<u>Flood Control</u>	<u>Water Supply</u>	<u>Recreation</u>	<u>Water Quality Control</u>	<u>Totals</u>
<u>SEPARABLE COST-REMAINING BENEFIT METHOD</u>										
Allocated First Costs	1,927	2,477	143	453	5,000	1,925	2,476	148	451	5,000
Allocated Annual Charges	74.8	105.9	11.9	17.7	210.3	88.4	123.1	13.5	20.8	245.8
Annual Benefits	100.7	120.0	176.0	49.0	445.7	100.7	139.2	176.0	49.0	464.9
Benefit:Cost Ratio	1.4	1.1	14.8	2.8	2.1	1.1	1.1	13.0	2.4	1.9
<u>PRIORITY OF USE METHOD</u>										
Allocated First Costs	2,258	693	1,362	687	5,000	2,159	692	1,355	794	5,000
Allocated Annual Charges	88.9	36.1	58.0	27.3	210.3	100.7	40.4	67.6	37.1	245.8
Annual Benefits	100.7	120.0	176.0	49.0	445.7	100.7	139.2	176.0	49.0	464.9
Benefit:Cost Ratio	1.1	3.3	3.0	1.8	2.1	1.0	3.5	2.6	1.3	1.9
<u>INCREMENTAL COST METHOD</u>										
Allocated First Cost	2,081	2,472	50	397	5,000	2,078	2,471	51	400	5,000
Allocated Annual Charges	84.3	105.6	6.2	14.2	210.3	99.2	122.8	6.6	17.2	245.8
Annual Benefits	100.7	120.0	176.0	49.0	445.7	100.7	139.2	176.0	49.0	464.9
Benefit:Cost Ratio	1.2	1.1	28.4	3.5	2.1	1.0	1.1	26.7	2.9	1.9